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Where a Saving Can be Made.

Improvements tending to a more economic production are continually being perfected in all lines of industry. The saving effected is in many instances but a fraction of a cent, yet it is eagerly sought for, because when the operation is repeated many times a day, the difference makes a large total at the end of a year or a month.

In looking through our foundries and especially our jobbing shops, the close observer must be impressed with the comparative slowness with which the molds are clamped up. Go into even a well-appointed shop, where there are plenty of clamps, blocks and wedges, and observe the length of time that is spent by the molder in securing his work. It has got to be secured somehow, and it would seem as if there could be found a cheaper way of accomplishing this.

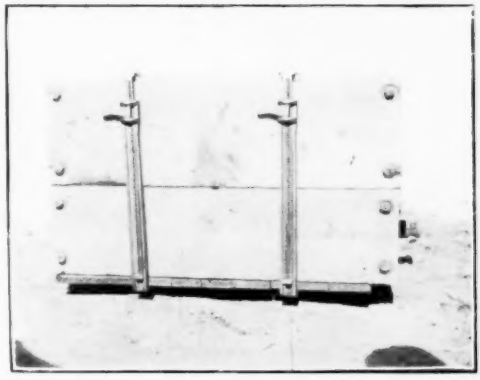


FIG. 1.

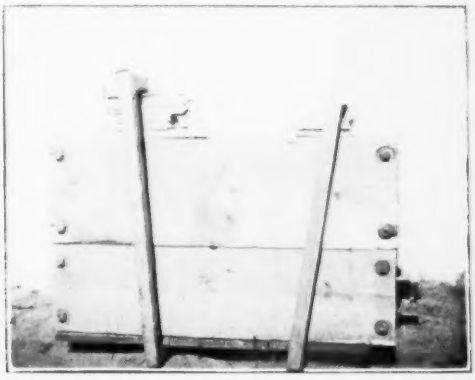


FIG. 2.

Several designs of adjustable clamps have appeared on the market, but they have not secured the ready introduction, which it was expected would be accorded to an invention of this kind. There are many who will say that our foundries do not appreciate and will not purchase an article which they have to buy, preferring to plod along with whatever contrivances they can make themselves, but this is not so, because our foundries are actuated by the same motives of business, in accepting and installing new improvements, as any other industry. We rather believe that the cause of our foundries neglecting to provide themselves with improved clamps has been, that the "new ideas" which it has been sought to introduce, have lacked the essential quality to succeed, that of actually effecting a saving. The remedy proposed has proved costlier than the disease, and the well-known conservatism of the foundries prevented a non-interest paying investment from being adopted. One of these clamps operates by a tilting device and can be adjusted to varying lengths, the difference between each point of adjustment being two inches. From this it is evident that blocking or wedges would still have to be resorted to, the same as with the ordinary clamp, so that the saving could only be nominal in any case. Another type is adjusted by a thumb-screw, but a small piece of flat iron must be provided to prevent this from sinking into the edges of the flask. Between furnishing these pieces and wedges the foundryman chose the latter, and another improvement failed of per-

manence. One adjustable clamp can be used without blocking of any kind, that is, it is adjustable to flasks of all sizes, but it is tightened by a wedge-shaped arrangement, which required a slight rapping to lock it. This is its only feature, to which exception can be taken, but the objection on this point is so strong against jars of any kind being administered to a mold, particularly those made of green sand, which compose by far the largest part of our molding, as to condemn any clamp involving the principle of being tightened by a hammer. All of these clamps are backed by a patent, but a thing isn't necessarily practical or economical because it has got a shin plaster from the patent office to show its legitimacy.

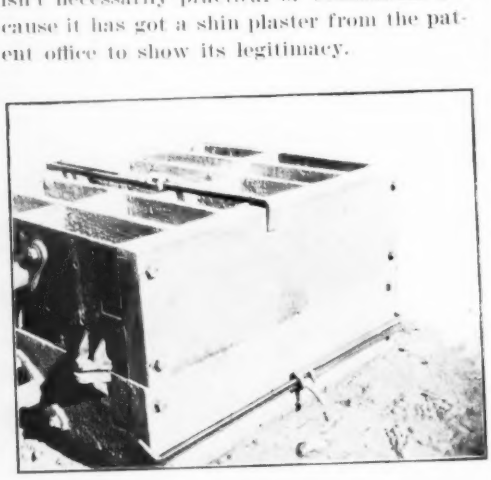


FIG. 3.

We believe the average foundryman is ready to accept any improvement in methods or appliances, when it can be shown that these will pay for themselves and leave a margin. When adjustable clamps reach the perfection desired they will be used. And they won't be used because they save wedges, either; these are cheap enough. The main saving will be time, and, of course, the time saved on each mold will be comparatively small, but in the aggregate it will foot up to many hours.

The most perfect and practical adjustable clamp which we have seen is shown in Fig. 1. It is tightened by simply giving the pawl half a revolution, and tightened so completely that it required a large clamping bar to pry it off the flask. The back part of these clamps have a thread cast on them which, in tightening, engages with a similar thread on one side of the pawl. The principle on which they work is that of a screw, the pitch being sufficiently coarse, to allow the two main parts of being drawn slightly together. Note the perpendicular position of the clamps, the proper one. Fig. 2 shows, by way of contrast, a couple of ordinary clamps as near as we would come in fitting half of the flasks in our jobbing shops. Fig. 3 shows the same clamps used for binding together the dray or cope part of the mold, when there is any apparent chance of springing. The entire absence of block or wedges is noticeable in all positions.

As facts and figures are what count in the introduction of anything new, the writer made some experiments with the clamp shown in Fig. 1 and the ordinary, illustrated in Fig. 2, under the most favorable conditions which could obtain in practice. The time required to place four of these adjustable clamps was fifty seconds, although this could be materially improved upon with experience. The time of clamping with the ordinary, two of which required simply a wedge, and the other two additional blocking, was five minutes. This period does not include the time required to secure blocks, wedges and clamping iron. If this were added, the time occupied would be considerably more, differing with the conditions under which these could be obtained. But let us suppose that the difference in time was four minutes and that a molder put up five flasks per day, this would leave at least twenty minutes a day, for one man, in favor of the adjustable clamp. A shop having eighteen molders would save six hours of molders' time per day, which at 25 cents per hour would be $1.50. Quite a respectable item at the end of a year.

In this calculation, however, we have vastly undervalued the time, which is spent in the average foundry, in clamping. It differs, of course, with different shops, but even the best equipped one can not compare its record with this clamp. It may appear, as if shops working on standard castings, and having clamps made to fit their flasks, could not secure anything better. These must be tightened by a clamping iron, however, and this can not be done as speedily as this clamp

can be adjusted and locked. Then, too, the clamping iron spoils the edges of the flasks so that after a time it becomes almost impossible to pry on the ordinary clamp. This clamp will hold as well on a splintered edge as on solid material, and can be used where an ordinary clamp could only be applied after much difficulty.

The ease with which these clamps may be put on and removed again makes it unnecessary to have a large supply on hand. A dozen clamps to a floor will, in ordinary work, prove ample. They are made by the E. E. Josef Mnfg. Co., of Buffalo, N. Y.

As said before, time is one of the principal items, though we know many castings are lost by the chance which is offered to apply the ordinary clamp in a haphazard manner. The excitement attending the clamping up of some molds, which have been left behind, is not conducive to sober thought or judgment. Removing the chance, the opportunity, to lose a casting is the surest remedy that can be applied.

Some Pencil Sketches of Failures.

By HENRY HANSEN.

When it comes to gating every molder has his own ideas, and I am prone to admit that very often, when a change is effected it is made for the worse. Substituting a good gate for an inferior one with more theory is a common occurrence. I am ready to acknowledge that there is more than one good way of gating a casting. Just as we may go to heaven by different routes no matter what each denomination has got to say about it, so we may get a clean casting by different methods, in spite of what the man who knows it all, prophesies. There are, however, certain fundamental principles involved, which can not be ignored, and upon which is based the successful working of all modes of gating.

I take it for granted that every molder will acknowledge that it is easier for dirt to pass through a large aperture than a smaller one. Admitting that it takes a certain gate area in order to fill the mold properly in a given length of time we are still able to retain a constant gate area by a judicious distribution. Figs. 1, 2 and 3 represent a gate, all occupying an equal area but placed in different manners. With the same pressure they would practically fill a mold in an equal length of time. If we ignore the factor of friction, which is increased as the surface of the gate is enlarged, I think all will agree, that the greatest amount of dirt can pass through Fig. 3 unmolested. A piece of slag, for instance, that could enter the mold without any hindrance in Fig. 3, would find a greater difficulty in entering through Fig. 2 and be still further retarded in its progress by the narrow gate Fig. 1. I remember a case where dirty castings were the rule, and the way the pig iron got the blame for it, which was entirely overcome by distributing the gate in a better manner. The cleanest castings will be found where narrow but long gates are used and the dirtiest where the gates are short and heavy, permitting impurities to pass unmolested into the mold when a narrow gate would retain them as a fine riddle keeps back finer pieces of scrap than a coarse one.

Aside from the gates being the means by which the metal is conveyed to the mold proper, it has been sought to incorporate in them with more or less success, such a form of construction as to compel them to absorb whatever impurities may have come with the iron from the ladle or been gathered in the passage of the metal through the runner basin and part of the gate itself. Green sand work being much more susceptible to the agitation of the metal, it is from here that we receive the largest complaint of dirty castings. To prevent objectionable matter from entering the mold, gates are shaped so as to act as a preventive against this, and one of the best preventives is to fill the mold through narrow gates which will largely prohibit the entrance of foreign matters.

Skimming gates take many forms according to the caprices of the foreman or the gullibility of the molder. Some shops, by careful gating, produce clean castings and ignore the skimming features altogether, while others would not think of pouring a grate bar unless a skimming gate is attached. The employment of skimming gates result in a correspondingly higher percentage of gates, and returns to the cupola and increase the cost to a certain extent.

There are two principles underlying all forms of skimming gates. The first, and this is the one most commonly employed, proceeds on the assumption that a light body will float on a heavier one. All impurities being lighter than iron they will raise to the surface and occupy the highest strata, and with the flow of metal directed through an entrance considerable below this, the source of supply is placed where it can be filled from the heaviest body. This principle is sometimes interfered with, and we will consider this feature later.

In the second principle upon which is based the effectiveness of the skimming gate, and this is sometimes found in combination with the first one, a centripetal force is applied to the metal either as it enters the gate (the whirl gate is an example of this), or as it enters the mold. A notable instance of this is to be found in roll making. By this method the impurities are by the centripetal force made to move towards the center where their presence is almost harmless, and away from the surface of the casting, where they would cause it to be condemned.

Letting Figs. 4 and 5 represent the plan and elevation of a skimming gate in which the metal enters at A, the flow will take place in a similar manner to that indicated by the direction of the arrows. Note that the outlet to the casting B is smaller than the connection between the pouring and the skimming gate C. This arrangement becomes very important, in order to insure the efficiency of the skimming gate, for if we construct them as shown in Figs. 6 and 7 with a channel at D the same proportion as the outlet to the casting E we deprive it of all chance to perform its duty; such an arrangement will neither skim nor whirl. The velocity of flow is constant from F to G in Fig. 7, while in Fig. 5 the metal has less velocity in passing through C than B. This permits the lighter bodies to raise and lodge in the skimming gate H. Fig. 8 shows an arrangement, often seen, wherein the skimming gate is of a smaller dimension than the pouring gate. If it was possible to keep this gate full, which I doubt, the only chance for catching any slag would be while the metal was passing the skimmer I or a distance equal to the space between K, L. The time occupied in passing these points must be very small and as lighter bodies, such as the dirt to be found in these places, are easily carried along with a high velocity of flow while with a low velocity they are given some time to appear at the surface and a chance to escape into the skimming gate it will be seen that any style of gate inducing a high velocity of flow while passing the skimming portion of the gate is to be condemned.

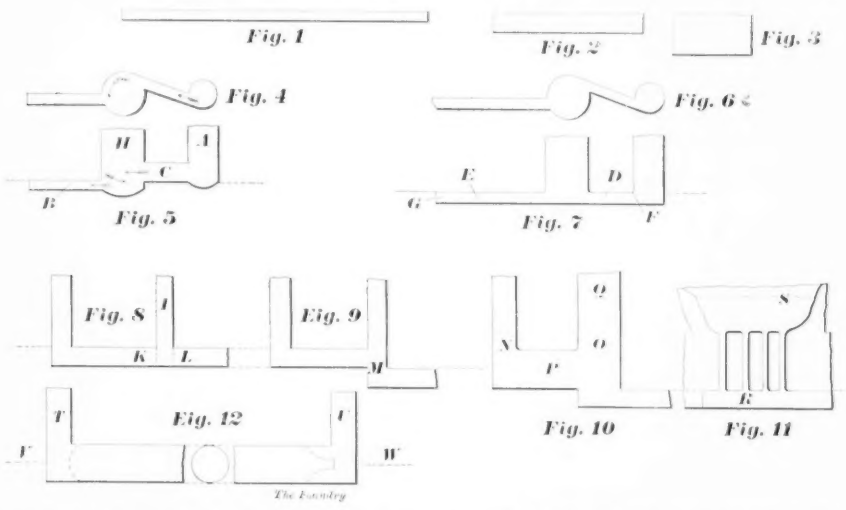


Fig. 9 has a distinct feature from Fig. 8. The connection between the pouring and skimming gate is formed in the cope while the gate proper is made in the drag necessitating the metal to take a downward course

at M, but whatever benefit should arise from the distribution is offset by the equal dimensions of the gate throughout. Fig. 10 shows an arrangement that is extensively used by molders both with and without the whirling feature. Once this gate is filled the metal must travel slowly from N to O. Any impurities found in the metal at this stage are given an opportunity to reach a higher point in the channel P or the skimmer Q, the supply at all times being taken from the lowest portion of the metal and consequently the cleanest.

Fig. 11 is an example of the Dutch skimmer. This is sometimes used directly on the casting and again the part R is made to form a connection with the casting. In any event its efficiency depends upon filling it quickly to about the line S, when the metal, as in Fig. 10, is constantly drawn from the lowest and cleanest strata.

We are reminded of the story of coal oil Jimmie. He got named that way because he could not make a good casting without employing some of the fluid, which we are favored with, through the kindness of Mr. Rockefeller. Now, Jimmie didn't use to have that habit, but one day some one suggested to him that he spray some coal oil on the mold on which he was making. The casting came out good and after that Jimmie couldn't get a good casting unless he sprayed the mold with coal oil. Force of habit makes us do some queer things and Jimmie was an example of the power it exerts upon us.

Fig. 12 shows a practice that is very common wherein a sash weight pattern is made to form the connecting link between the gates T U. I worked for a foreman who was so wedded to its use that he insisted it to be an impossibility to make a clean casting without a sash weight although the use of this arrangement would many times necessitate the employing of a larger flask. He was another victim to force of habit. When we come to analyze the principle by which the sash weight becomes so effective as a skimmer, it is seen that the gates to the casting are drawn from below the joint line V W. In pouring a casting any impurities in the metal are offered the benefit of a low velocity while supplying the gates from T to U. All skimming gates, no matter what is their shape or mode of construction, must be kept full in order to be effective. They only perform, what is expected of them, so long as we permit the lighter bodies or impurities to find a ready outlet through the correspondingly heavier mass of iron. All effective skimming gates are based upon the laws of gravitation and when we interfere with these laws our skimming gates become inoperative.

The Value of Chemistry in the Foundry.*

By S. S. KNIGHT.

The subject which your secretary has chosen for me, that of "Chemistry in the Foundry," is one that I am glad to have the privilege of discussing before the convention of American Foundrymen, since American foundrymen, as compared with those of other nationalities, stand at the head of their profession.

S. S. KNIGHT.

I am thankful to have the opportunity to present to you a question which in the foundry business has so great a bearing on profit and loss, and which, it seems, judging from the few foundries containing chemical departments, has never been brought before you with its full significance, has never been

* Paper read before the Convention of the American Foundrymen's Association, Detroit, May, 1897.

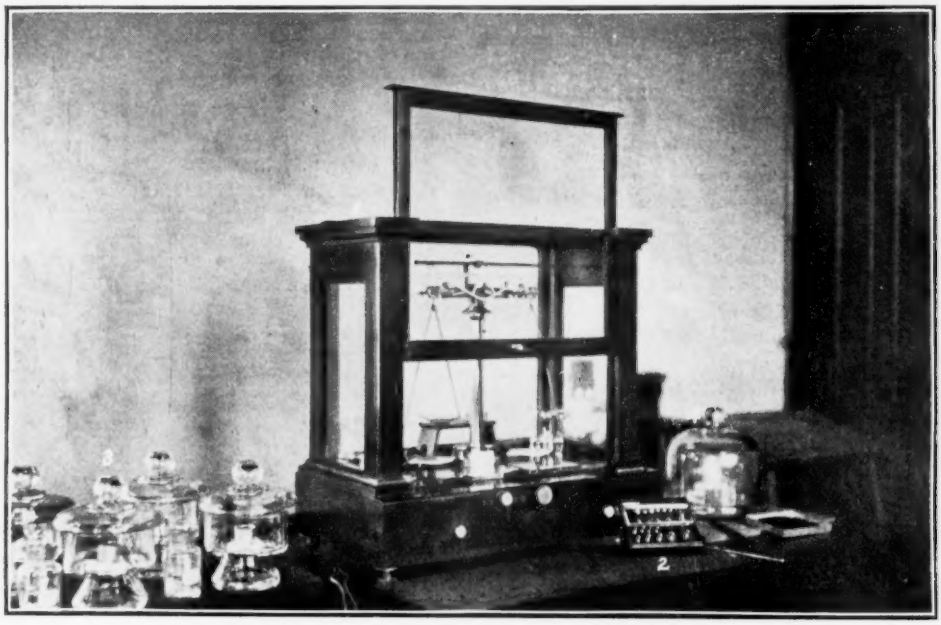
treated as a financial investment; in brief, has never been shown to be a question of dollars and cents. My purpose this afternoon is to present the plain facts of the case in the simplest manner possible, and to adduce from them such conclusions as naturally follow.

In speaking of chemists in this paper, it will be understood that more is implied than men who have merely a theoretical knowledge of the subject. The fact is that theory alone is the smallest part of the requirements of an iron metallurgist. Commercial interests demand men of practical worth, not those who can analyze only, but those who can use their analytical and synthetical knowledge to cheapen and better salable products of commerce.

The cost of installing and maintaining a laboratory is generally the chief objection to the application of chemical knowledge to foundry work. This cost, as a rule, is greatly over-estimated. To my knowledge, one of the best laboratories that could be wished for was put in at a cost of less than $1,000. For all ordinary foundry work $100 worth of chemicals and $300 worth of apparatus will answer and will, if placed in the hands of a competent, practical man, pay 100 per cent profit on the investment in one year's time. As to how this can be, will now be examined in detail.

Since iron is the chief material used in foundry work that will be considered first.

As is well known, most furnaces grade their iron upon fracture, since most of their customers will have no other means of judging its quality when received. I have known of southern iron which was close, when advised as 2 soft to be rejected, although it contained over four per cent of silicon and no other elements in objectionable quantities. Here certainly an analysis would have been a great advantage to the receiving foundry. On the other hand, we have known the same firm to take an open large crystaline iron as 2 soft when it contained less than one and eight-tenths per cent of silicon and nearly two per cent of phosphorus. Here again a laboratory would have proved of great value and would have, in this case, saved many castings.



WEIGHING TABLE.

1—Balances. Sensibility .00000170 Ounce.
2—Platinum Weights.
3—Desicators with Platinum Crucibles.
4—Large Desicator and Platinum Crucible

When you consider that only two elements can be even approximated by physical or mechanical means, then the importance of chemical facilities becomes extremely plain. An excess of phosphorus and sulphur may ruin a casting just as easily and surely as a deficiency of silicon. In much work it is far more dangerous. Castings which must withstand heavy strains or acid action must not exceed a prescribed limit in either of these elements. If metal be required which shall have special properties, how else but by chemical means can these be determined? Thus acid castings have been found to require about one per cent of silicon, five-tenths of a per cent of phosphorus, five-hundredths of a per cent of sulphur, and three per cent of carbon. By experiment and analysis it has been found that architectural iron should run about as follows:

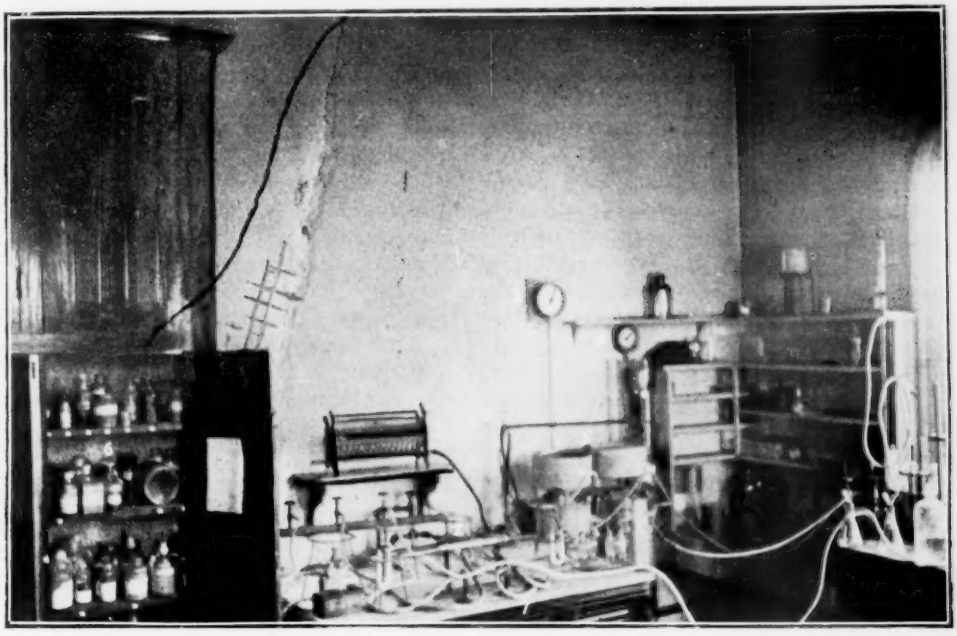
Silicon—Nine-tenths of a per cent.

Manganese—Three-tenths of a per cent.

Combined Carbon—Sixty-five-hundredths of a per cent.

Graphite—Two and five-tenths of a per cent.

Such metal has been made by careful analysis and computation of constituent irons which would stand a tensile strength of 40,000 pounds to the square inch section, and so that when exposed to a two per cent solution of sulphuric acid for twenty-four hours at sixty degrees Fahr. that less than seven-tenths of one per cent dissolved. To attempt to mix such iron as that by fracture in the face of what has been shown concerning the fracture and the reliance that can be put upon it, would be supremely absurd.



BLAST LAMPS AND STAND.

1—Combustion Furnace.
2—Combustion Tube of Platinum.
3—Oxygen Pressure Gauge.
4—Water Pressure Gauge.
5—Oxygen Tanks.
6—Chemical Case.
7—Blast Table.

Some shops are at present using soft iron tools—tools cast from iron instead of steel. It may seem strange to those not connected with chemical work, that the irons used in making tools, which are frequently high-priced, make no better tools than common machine borings, providing an ore preferably spathite be used for a flux.

Coming back to the question of economy. Is it cheaper to use high-priced irons and mix by fracture or to use low-priced "off grade" irons and mix by analysis? In many instances I have known fifty cents a ton to be saved in this way alone, and in one special case, one dollar and fifty cents a ton. But what is far better than the saving in cost of material, is the certainty with which the product is manufactured.

If a chemist be conscientious, and thoroughly inspects everything brought in, the cost of establishing and maintaining a laboratory for one year will be paid in two months. The scrap should be analyzed and then there can be no question as to how much scrap a mixture can carry. Often much of the trouble that is placed to the credit of the scrap really is caused by the coke. I once saw a large shop lose casting after casting without being able to detect the cause of the trouble. The mixture was changed, but still the iron was bad. Analysis of the coke settled it all for it contained two per cent of sulphur. For this coke they were paying seventy-five cents a ton more than was subsequently paid for a coke that contained less than one-third of that amount. The difference was caused by the establishment of a laboratory. They were using forty tons a day of this coke, so on the first price alone the laboratory paid for itself in half a month. Another thing that must be watched is the ash of the coke. If more than ten per cent is ash, then you are paying just so much a ton for dirt. The ash of coke can only be told by analysis, and likewise the phosphorus. Both are detrimental if existent in large quantities. Here again is a saving which may be credited to the laboratory. While considering coke let me say that quite a portion of the product now on the market is the so-called dead coke. After the flame has left the fuel and the coal has been properly burned, it is no uncommon thing to leave the coke still in the oven in order to retain the heat for the next charge. This, of course, greatly deteriorates the quality of the material, but by its appearance it is impossible to distinguish this from the good coke. In available heat units, however, the dead coke may be fifteen or twenty per cent below the good product. Here we see another saving which the chemist only can make.

Coming to the subject of coal, you are all acquainted with the price that is usually charged for coal suitable for the forge. By analysis it is found that this high-priced coal is almost identical with a lower grade and a saving of forty per cent may be inaugurated in the cost of this necessity. A furnace coal which was used in a certain shop was analyzed and found to be less than ten per cent as efficient as a lower-priced coal, and practical boiler tests calculated in horse power and pounds proved the correctness and practical utility of chemical advantages in this case.

And next we come to fluxes, and slags in cupola work. Here is where chemistry scores another decided point, in reducing the amount of flux used and the character of the slag obtained. By the analysis and appearance of the pig metal, the chemist can tell how much and what kind of flux to use. In most cases none is needed since the ash of the coke is sufficient to carry off all sand and impurity, but if trouble is found in dumping the cupola, a few shovels full of lime-stone may be added to the last dozen charges. In most places where laboratories are available no spar is used and but little lime-stone. This, of course, could not be done with safety where chemical knowledge was not utilized, since on one brand of iron it might work well, while on another it would cause trouble. The saving in lime-stone occasioned you will note, and like all others will be great, just in proportion to the amount of work turned out.

Concerning sand, we would say that here, as in all other products consumed, a great saving will be occasioned by the use of chemical science. The carbonaceous material is of no value, while the contents of alumina and silica is of the utmost importance. Too much clay is very bad since the mold will not vent properly on account of being too compact. If facing or sea-coal is being used on the molds, clay will make the castings scab, and thus ruin them for the market. If such should be the case, the use of molasses water as a menstrum for mixing the blacking instead of clay wash will remedy the trouble. Again the analysis of the blacking is of great value. You may be assured that no facing will give satisfaction if its fixed carbon is below eighty per cent, or if it carries over ten per cent of volatile hy-

drocarbons. It also must be refractory, or if not and used on heavy castings, it will burn off, causing scabbing.

The analysis of facing will save many castings from the scrap pile, and thus directly bring about a saving of no little importance.

Since most of the graphite used is made by the fusing of iron with ground carbon instead of from the mineral, foundries have to constantly be on the look-out for high iron-ash in this material, which greatly increases its weight, and decreases its value. As graphite is sold by weight, you will at once recognize where the laboratory again masters the situation and I have known a saving of no less than thirty per cent in cost alone to be due to analysis, while the salable product was greatly augmented in quality.

Coming now to the less important substances, such as brick, fire-clay and lime. All of these substances should be tested by the chemist. Since the brick in a cupola are usually quenched at a high heat, it is important that they do not readily absorb water. If the water enters the pores of the brick, it will, when vaporized, tend to break down its structure and disintegrate it. Samples may be taken and heated before the blow pipe to one thousand degrees or even one thousand and five hundred degrees Fahr. and be quenched, thus duplicating the condition to which they are exposed in actual use in the cupola. This should be done before buying, and the purchase made in accordance with the observations made in the laboratory.

Fire-clay may be mixed and dried and then treated in the same manner. Lime should be analyzed and that having the most calcium oxide taken. No lime is cheap that contains less than ninety-five per cent of pure lime. The magnesia content should be low. Insoluble matter is of little importance since in any good article it exists in so small a quantity. By the use of these tests, I have known ten per cent of the cost price to be saved, which in large shops readily amounts to significant sums.

The saving on oils and such necessities, although they are not used in enormous quantities, yet in a year's time will be noticed. I recall an instance where a fifty-gallon drum of gasoline had been purchased graded as eighty-seven proof, the hydrometer test showed it seventy-four deodorized, and thus caused its rejection. In that one case forty per cent of the cost was saved.

And so one might go on and point out place after place where a laboratory in the hands of a competent chemist would save expense, but the examples of the utility of chemical knowledge which have been shown should be amply sufficient to convince even the most skeptical that no foundry, unless very small, can afford to be without one. In these times of competition, when every article is reduced to the lowest possible figure, and every avenue of expense so materially decreases the profit of the manufacturers, the quality as well as the price of every purchased article must be carefully watched. Besides this, many firms are requiring in their specifications the analysis of the salable product, so that being without chemical advantage in this age only means the inability of the firm to compete on many articles. Gas plants and chemical works, which are being erected, are furnishing a large quantity of work for foundries, and can only give their orders to plants furnished with chemical facilities, since they must have their castings of an approximately definite composition.

Alkali kettles, flanges, fittings, digesters, retorts and acid boxes all must be made according to the composition presented in the specifications, so that only those places which mix their irons by chemical analysis can compete for this work.

We must also consider the certainty with which mixtures are made in foundries that employ competent chemists. The percentage of loss is very small in such foundries, and any difficult work may be undertaken with nearly a certainty of success. The satisfaction which this method gives may be judged from the fact that a single instance has yet to go on record where a laboratory was installed and a competent chemist employed that ever subsequently did away with their chemical department. This is a most significant fact and speaks more for the efficiency of the laboratory than any thing else could.

Before concluding, I wish to call your attention to the fact that all of the larger corporations in the foundry, as well as in all

the other branches of manufacturing industry, have risen to and maintained their places in the commercial world, in more than nine cases out of ten, by the employment of scientific knowledge, and not unusually has this knowledge been either directly or by implication of a chemical nature.

The blindness and ignorance of the past are no criterion by which to judge the requirements of the future. The time is not only approaching, but is already at hand, when any foundry that expects to do more than a local business, must necessarily be equipped with all the advantages of modern times, not among the least of which are chemical facilities, so that they may not only be able to buy the best material for the lowest price, but also that they may operate with the least waste and turn out the finished salable product of the best quality and in the shortest time.

Gating Small Patterns for Brass.

By C. VICKERS.

Although the manufacturer is fully alive to the economy of "gating" small patterns from which quantities of castings have to be made, he is not always as well informed of the advantages to be gained by having the gates so shaped as to best suit the peculiarities of the metal in which they are to be cast. In these few remarks I will endeavor to point out the best way to gate patterns from which brass castings are to be made, so as to produce the greatest percentage of good castings with the least expenditure of time on the part of the molder.

Fig. 3 shows the common way of gating, in this instance, a set of small bushings. In Fig. 1 is shown the same set of patterns, gated so as to give the minimum of labor, in molding, with the maximum of good castings. It will be observed that the runner, Fig. 2, is molded half in the cope and half in the nowels. This feeds the castings better than the runner shown in Fig. 3, which is in the nowel only. In order to insure easy withdrawal, it is given plenty of taper both ways. On that end of the gate where it is intended that the sprue shall be placed, is a knob, Figs. 1 and 2. In the nowel this forms a small flat disk, while in the cope it rises about an inch and a half above the top of the runner. In order to explain the office of this knob, it will be necessary to give a brief description of the method of molding which accumulated experience has shown to be the best for small work, because producing the cleanest castings.

We will assume that the nowel has been rammed and rolled. This operation is practically the same with all classes of molding. Powdered rosin, or rosin and charcoal, is dusted on for a parting (as lake sand would spoil the sand pile). The

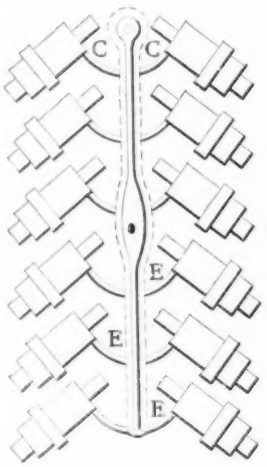


Fig. 1

Fig. 2

cope is now rammed up with no provision for a sprue; the top is leveled off and a smooth board bedded on, precisely the same as the bottom board of the nowel. The cope with the board is now lifted. This operation is facilitated by having some person "rap"—that is, strike the sides of the molding trough alternately and rapidly with the fists, or with specially constructed rubber-faced "rappers," so as to cause a vibration of trough and mold. The cope is now inverted and the sprue cut, with a brass tube called a sprue-cutter. The cavity formed by the knob prevents the sprue-cutter from crushing in the sides of the molds at C C, Fig. 1. With Fig. 3 care is necessary to avoid spoiling the two castings next the sprue B B by crushing. In order to be safe, a hole

must first be dug with the tools at D, and, of course, this consumes time.

The sprue cutter leaves a straight hole through the cope. Now when the patterns are drawn, it is unavoidable that small portions of the edges will be loosened. In order to set these firmly and quickly back to place, the cope is tried on, and at the same time the mouth of the sprue is widened to a convenient bell shape. The cope is again lifted off to allow of the mold being finished. Nothing would be gained by using a wooden sprue pattern and ramming it in the cope, as in the case of snap-flask molding in the iron foundry, because it takes as long to place this pattern as to push the cutter

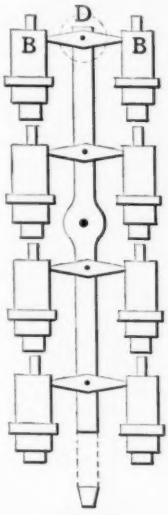


Fig. 3

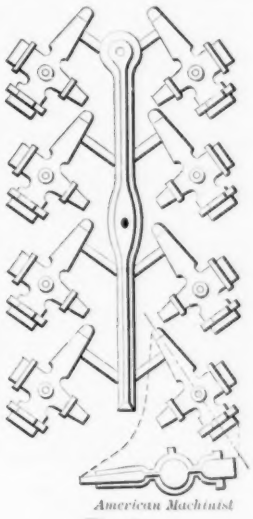


Fig. 5

through the sand, and it would not be so convenient to level the cope with the smooth board; and without such leveling "strained" castings would be too familiar, and if the cope is not tried on, the bellows cannot be used the same as when all parts of the mold are firm; consequently, we would have more or less dirt, or, in case the bellows were used, small loose pieces around the edges of the molds would be dislodged, producing an unsightly joint. The runner, Fig. 2, is cast solid, and holes are drilled through the sides along the parting line, at the proper intervals, through which the gates E E, Fig. 1, are passed and secured by solder or rivets, or both. These gates are made of round brass wire, the diameter of which is proportionate to the amount of gate required. They are bent so as to form part of a circle, the ends curving towards the knob end of the runner, as shown at E E, Fig. 1.

Why these gates are curved instead of straight is explained by the method of pouring illustrated at Fig. 4. It will be seen that the flask is inclined; consequently the metal will rush to the bottom of the runner, and the molds farthest away from the sprue will get first metal. The metal then rises, filling each gate as it reaches it, the ones nearest the sprue being last. It will be seen, therefore, that this shape of gate is an adaptation to that method of pouring which experience has shown to be the best. If, for instance, the sprue was located at the other end of the runner, so that the metal would have a direct shoot into each individual

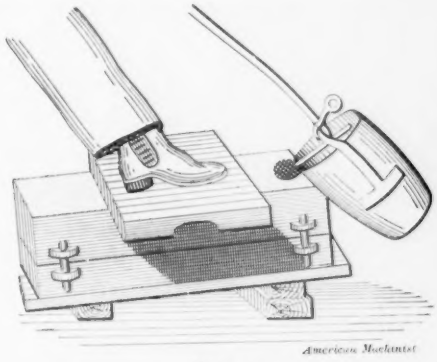


FIG. 4.

mold, the metal, in its rush down the inclined runner, would not fill each mold immediately, but would throw a little metal into each gate, which, becoming partially chilled, would have a tendency to produce "cold-shuts," especially in thin castings. It must be understood that the writer does not claim that if the sprue is placed at the wrong end of the runner, or that if the gates are straight, that the castings will all be bad, but only that the percentage of bad castings will be greater than with the method above described.

In Fig. 5 a gate of waste cock is shown, gated in accordance with the rules above mentioned, and yet this gate will only produce good castings under certain conditions. They are generally cast in yellow brass, and the aforesaid conditions are that the metal must be hot as possible; if it is chilled even

in a slight degree, the whole heat will be worthless. Why is this? It will be noticed that each casting has a small projection, or "tit," in the center. Its office is to drain the water from the pipe that has been shut off by the cock. This "tit" is generally molded in the nowel, although some foremen, on account of the trouble to be described, imagine that they can overcome it by molding the "tit" in the cope. This is all imagination, however, as the result will be the same in whatever position the "tit" may be, if the metal is not boiling hot. The trouble is

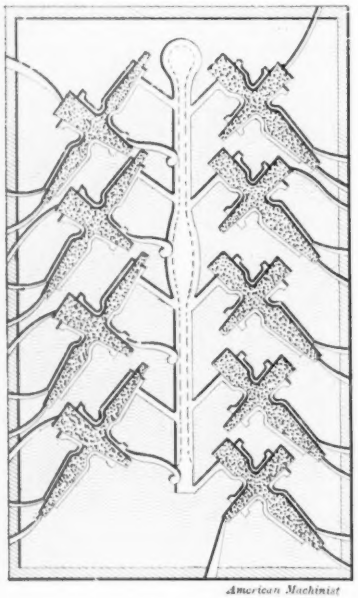


FIG. 6.

caused by shrinkage, which occurs inside the barrel where the plug fits right underneath the aforesaid "tit." The part of the casting where the gate is placed is extremely thin. The gate is placed at this point in order to make sure the thin portion "runs." When the metal is very hot this thin portion will be kept fluid long enough by the heat of the gate to feed the shrinkage of the comparatively heavy barrel. But when the metal is cool, the thin portion solidifies so rapidly that the barrel has to take the metal to supply its shrinkage from the heaviest portion of itself, namely, the "tit"; this shrinks on the underside, because the core being dry, does not abstract the heat from the metal so rapidly as the damp mold; consequently the skin of congealed metal is thinner at this point than on the outside, and result is a hollow that makes it impossible to fit the plug tight. The remedy is to gate the other end, as shown in Fig. 6. In order to insure the thin portion running, vents must be drawn from the thin end, at the mold joint, and carried to the joint of the flask, as shown at B B, Fig. 6, and the metal must be thrown in. Gated, vented and poured in this way, these castings can be poured comparatively cool.

In the other half of mold, shown at Fig. 6, there is shown the same cock, with both ends thin and alike. In this case an additional gate must be run to the barrel, as shown at C C, in order to avoid shrinkage at this part.—American Machinist.

Re-Discovered.

There has lately started around the trade journals an item, clipped from a German publication, showing how to cast a journal on a broken roll, or burning on a "neck," as we call it on this side. The whole thing is dished up as if it was something new, while the truth of the matter is that Messrs. West and Bolland have both treated this matter in their books published years ago, and we believe in a more practical manner than is illustrated in the present case. To some people, who don't keep posted, new methods are easily discovered.

One of the papers reprinting this item, adds that "the ladle should contain about three times the amount of iron necessary to fill the mold" in order to make a sure job of the burning. This advice may be well meant, but we fail to see wherein the amount of iron necessary to fill the mold bears any relation to the amount of iron required to burn the piece on. Further on, in the same article, we are told that we should have at least 300 pounds of iron to flow through. If the writer had been experienced in this class of work he would have known that the part to be burned on often weighs more than this. The amount of iron needed for operations of this kind depends on so many different conditions that definite advice of this kind is like figuring on horse racing and it is at least unreliable if not out of place.

We are willing to give credit for everything, but we are rather surprised at some of our American contemporaries jumping at a thing whose sole claim to originality lays in the "Dutch" twist of the illustration.

A TECHNICAL JOURNAL DEVOTED TO FOUNDRY INTERESTS.

THE FOUNDRY

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THE FOUNDRY

Is issued promptly on the first of each month, and will spare no endeavor to furnish valuable news and information to those interested professionally or incidentally in molding, melting, mixing of metals, foundry management, etc. Persons connected with any of these lines of industry will confer a favor upon the Editor of this Journal by sending him news from their section of the country pertaining to the foundry interests, particularly individual theories and experiences of practical value.

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Trade Outlook.

All doubts as to the permanency of the change for the better in commercial and industrial conditions have been removed by later developments. Fears were at one time entertained that an era of wild speculation would follow the rising market, but later events have checked the disposition to overtrading.

Buying on a large scale cannot continue indefinitely, and sellers as well as buyers welcome a breathing spell so they can see where they stand. Practically '97 is provided with all the business that can be handled, and before breaking into '98 it is desirable that there should be a more definite understanding in regard to a variety of subjects pertaining to business conditions. There is no apparent reason for revising expectations in regard to the magnitude of the demand, but there is a vagueness in regard to values that suggests extreme caution, particularly from a seller's point of view. Prices may be said to be abnormally low, although they are certainly much better than during the early summer, but a demand during the next twelve months such as we have had for several weeks past could not fail to lift prices very much beyond their present level. That such demand is probable the trade all believe, hence the indifference that is felt in regard to quoting for next year's deliveries.

Besides rumors of an intended raise in the price of coke, which adds to the uncertainty of quoting future prices; there also appears the probability of an advance in wages being asked for by those engaged in the iron and steel industries. Railways are considering the advisability of increasing their rates, and while any readjustment of these will undoubtedly be conservative, still the situation affords no stability on which to base future prices.

In this connection it is curious to watch the stand taken by some of our worthy contemporaries on the question of increased wages. About a year ago the editorial pages of these journals were, almost without exception, filled with the commandments of a certain political catechism, and in their efforts to make converts they promised those who would accept their faith immunity from almost anything that could be thought of. To-day these same professors are tooting an-

other tune from their horn, to the effect that workingmen should be slow about asking for advances which conditions do not warrant. If these journals were ignorant enough to make promises, which they knew could not be fulfilled, shall we blame the workingman for being ignorant enough to insist on their redemption, as they see it?

Reports from the chief manufacturing centers show that foundries following special lines are busier than they have been for years. Jobbing shops seem also to be benefitted by the general revival. In fact, many have contracted to almost their full capacity, while others are running full time but short-handed.

Will Increased Knowledge on the Part of the Molder be Appreciated and Paid For?

In an article on "The Decadence of Mechanical Ability in the Foundry," appearing in "The Tradesman" for September 15, E. H. Putnam deprecates the specializing which has taken place in the trade, and says: "A good apprenticeship system, subscribed to by the operators and the molders generally, is the one thing absolutely necessary to the equilibrium of supply and demand in the matter of skilled molders."

In studying industrial problems of this kind, we should consider the economic conditions of the question and not be swayed by any sentiment or emotion which may for the moment overtake us. This is a world of business, which will not be deflected from its course by the mere signing of an agreement.

Admitting that the possession of a good education favors its owner universally, we desire to say, that a place must be found for the utilization of ideas before these will be paid for. If our country was full of skilled molders to-day, men with a general knowledge of the whole foundry business, these would not find a ready entrance to all shops, because a general knowledge of the foundry business is not essential in the largest part of the trade.

To make the illustration more direct, we will suppose that Mr. Putnam is conducting an agricultural shop and that he is in need of molders. Two molders make application for a job, one who has never worked outside of an agricultural shop, and maybe he knows only enough to make a certain casting, which we suppose is the kind Mr. Putnam wants, but the man is muscular and strong and he has a reputation for getting to the back end of his floor every day. The other is one of your much-wished-for good mechanics; he has served a seven years' apprenticeship in all classes of work; he knows how to run a cupola, he knows how to make cores, but this man is not so strong as the former; he has no pedigree for turning out work. Which of these two men will Mr. Putnam hire?

We will suppose that prosperity has struck his neighborhood and that he hires both of them; which one will he pay the most? Suppose they turn out the same amount of work, which one will receive the highest wages? Will the knowledge of how to run a cupola and make cores enable the skilled mechanic to turn out more plow points than the other one, who knows nothing else? Will Mr. Putnam pay these molders according to what they know or according to what they do?

We have put the questions in this light in order to show that much of the information with which we invite our molders to fill themselves up will not yield them any returns until they obtain a place where this information can be utilized. At least 95 per cent. of our molders are hired to mold and nothing else. Any knowledge which increases their ability to mold, or, in other words, to turn out work at a less cost, increases their ability to earn. Anything else which they acquire must be classed merely as an accomplishment.

The foundry which is turning out plow points will not thank a molder for his ability to make a marine cylinder, nor will it pay him more for knowing how to run a cupola than it would if he knew how to ride a bicycle. If our foundries actually wanted molders with a general knowledge of the trade would there have been so many jobbing molders out of a job during our past depression? NIT! This IS an age of specialties and the molder who can make the kind of castings a foundry is in need of fills the bill, while the one with a general knowledge of the whole foundry business will be paid according to his producing capacity and not according to his knowledge.

Go into our foundries and observe that our specialists, the men who know how to do

one thing well, are in many instances receiving more money per day than the first-class molder, with his long apprenticeship. The cry of poor workmanship at the present day is largely a bug-a-boo, kept alive by pessimistic fossils, who can find nothing else to talk about. Go into our stove foundries and tell us how their castings compare with those made a generation ago. Is there a single stove foundry in the country which will subscribe to the fact that it is making a poorer quality of castings than it was a decade ago?

Where is the agricultural shop that is not making good castings? Where is the jobbing shop? Let us know the truth. Where are these shops which are suffering from the "decadence" of mechanical ability? How can there be a "decadence" of mechanical ability without a corresponding decadence in the quality and quantity of the product? Changed conditions have brought us into specialties and we are there to stay, but the quality of our work has in no way deteriorated by this. On the other hand, both quality and quantity have increased and we have reached greater exactness. It is not necessary nowadays that a molder shall know how to harness a mule, nor that he shall know how to do anything outside of what the foundry employing him demands.

The molder working on a specialty is more expert in his special line than the general molder would be. He is able to turn out more work than the general molder, and he is worth more to his employer. He is paid for what he does and not for what he knows. Of course a general agreement might reverse this, but we sincerely doubt that the time will ever come when the molder who turns out the most work will not receive the highest pay, irrespective of his knowledge about something which the foundry employing him does not care to utilize.

We have, by the subdivision of labor, increased the producing capacity of our molders to such an extent that no matter what kind of agreements are suggested, the question of going back to the old times of general foundries, with their excellent and necessary opportunities for becoming thoroughly acquainted with the trade, is entirely out of the way. We measure men simply by what they do. The "equilibrium" in skilled molders will be established when they receive a direct benefit for having procured a general knowledge of the trade.

Let Them be Useful as Well as Ornamental.

A glance at the large number of journals published in the interest of labor unions and their members will impress the reader with the abnormal amount of space devoted to matters of secondary importance to their respective constituents.

If it were not for the fact that the front cover usually offers some identity to its publishers, one would believe most of them to be issued in the interest of some school of political economy instead of a union of practical mechanics. The absence of anything pertaining to the trade they represent is to some extent a sure sign that their members are thinking more of somebody else's business than their own.

We can conceive of no case wherein a knowledge of political economy is going to help a man to become a better mechanic. It is to be commended as an accomplishment, of course, but still we believe most workmen need a course in arithmetic more than they require lessons in politics. The former they can use, while the latter must lay dormant, until it can be utilized to influence the election of some favored candidate.

There is something comically absurd in a mechanic writing treatises on the single tax, when in ninety-nine cases out of a hundred the writer has not got a blessed thing to tax. Such a man would profit more if he would write a paper on "How to Drive a Ten-penny Nail," or kindred subjects, instead of trying to solve questions which men with greater brains have given up.

When we see a journal of this kind filled with a lot of semi-political mush, and the next election observe its readers scattered among all kinds of political organizations, shouting themselves hoarse for everybody, we cannot help feeling that a great deal of good paper and ink has been literally wasted.

It appears to us as if the poorest mechanic who owns nothing, is the first one to suggest serious alterations in our governmental garb. When a man accumulates even a small amount of property, he becomes less radical

in his views, because he realizes then that he cannot inflict injury upon others without hurting himself. Any article on any subject, written with a fair degree of common sense, may be printed almost anywhere, but why every imbecile should be allowed to show his ignorance on paper, that could be put to better use, is past finding out.

The members of a trades union may to a certain extent be blamed for letting their organ be occupied with nosensical rubbish. However, any editor, with even a dull pair of scissors, ought to be able to find sufficient material of mechanical interest to his constituents to fill the greater part of his publication. The best matter a journal of a union can print is something which enables its members to earn more money and to become better mechanics.

How Much Have Wages Been Reduced?

The tendency of wages is always downward, says one of our contemporaries. And looking at the reductions which have taken place the past few years, it would seem to be so. There is one phase of the question, however, which those who are expert in talking of reductions seldom allude to, and without which the discussion of reductions and their effect can have but little value.

Our wages are not represented by the weight of the money we receive for our labor. They are determined by what that money will buy and the comforts it will provide us. While a universal reduction in the amount of money paid as wages has taken place, it is also true that, dollar for dollar, our wages to-day have a greater purchasing power than formerly. If, for instance, a mechanic who earned $3 per day had his wages reduced to $2.40, or 20 per cent., and he could purchase as many comforts for the last amount as he could for the former, how much would his wages be reduced?

We often hear of wages being reduced for making certain articles, when in fact such is not the case. We will suppose that a molder is paid 20 cents for making a certain casting and that facilities are provided whereby he is enabled to turn out two castings in the same length of time he formerly did one. Under the new method he is paid 10 cents. How much is his reduction?

There are generally two sides to a question and fortunately the reductions which we have witnessed are provided in that manner. We may be pessimistic and yank around fifteen yards of figures to prove that reductions in the wages of the workingman have not been accompanied by reductions in anything else; but it is apparent, when we look at this question on all sides, that the actual reduction in the comforts which our wages will purchase is not anywhere so great as some would lead us to believe.

Some Things That Are Queer.

In a book, entitled, "Practical Iron Founding," published a few years ago in England, there appears an account of a certified test of Stewart Patent "Rapid" Cupola No. 4, at Messrs. Rushfort & Co.'s, St. James' foundry, Bradford, June 26, 1885, in which it is claimed that 20,160 pounds of iron were melted with a total fuel consumption of 1,232 pounds of coke, or at the ratio of 1 to 16.36.

We have always contended that an improvement possessing real merit will secure its own introduction. If these figures were not doctored, the Rapid Cupola should have had a large sale, because this performance eclipses our melting to-day, and we have had twelve years of improvements since then, and, besides that, we have become experts in claiming high ratios, but we cannot touch this back number.

We are led to make these remarks because a few months ago one of our wily Canadian cousins betook himself and a process for melting iron to England, and after making tests and getting out a set of renovated figures, he claims to have secured a hundred thousand pounds sterling for his method. This would not be so strange, only for the fact that in his published test the melting ratio is shown to have been 1 to 7.35. In view of the fact that the "Rapid" Cupola melted at the rate of 1 to 16.36 in 1885, what are these citizens of Great Britain who paid their £100,000 going to do with their patent 1897 process, which consumes twice the amount of fuel?

Metal for Locomotive Cylinders.

At a recent convention of the American Railway Master Mechanics' Association, one of the members gave a mixture* used in making metal for locomotive cylinders, valves and valve seats. This mixture consists of 20 per cent. steel castings, old steel springs, etc., 20 per cent. No. 2 coke iron and 60 per cent. scrap. From this it was stated a good solid metal could be obtained, the castings being free from honeycombing and finishing better than the ordinary cast-iron mixture, over which it had the advantage of 24 per cent. greater strength. Its constituents are: Silicon, 1.51; manganese, 0.33; phosphorus, 0.65; sulphur, 0.068; combined carbon, 0.62; graphite, 2.45. We fear, however, that ironfounders would have difficulty in melting a mixture of this kind in an ordinary cupola.—The Trade Journals Review, Manchester, England.

(Why the Review should doubt the expediency of melting such a mixture in the ordinary cupola we do not know. The very same mixture, or modifications of it, has been used for years under the name of semi-steel, and other more or less voluble designations, and no trouble has been found in melting it. Its chemical constituents do certainly not show any reason why it could not be melted in the ordinary cupola. We think the Review is doubtful, because the mixture is alluded to as cast-iron instead of being furnished with a high-sounding name, which, to the uninitiated, often commands a greater respect.—Ed.)

*Published in the October Foundry.

Krank's Korner.

Somehow or another whenever I run across a well equipped foundry, it always seems to me as if a machinist owns it. I am not going to kick against him because after all, he makes a good boss, if he is—a machinist. Being such, he does not expect any perpetual motion scheme to work anywheres, nor is he waiting to get something for nothing. He will not expect that his men are going to increase their output by working for sympathy. When I see a machinist, with a large foundry, doing well, I admire him, but still why couldn't molders do just as well?

And when in the distance there appears a tumble down concern with a lot of old, burned out, flasks for a sign, I am pretty sure to find—not a machinist, but—a molder at the head of it. A molder who tries hard to do the biggest day's work himself, pays his molders a dollar and a half a day, and sometimes less, grinds his own facing and is on the jump from morning till night, and still he never gets beyond the mongrel shop he occupies. Why is this thus?

Many a first-class molder has made the biggest kind of a failure when he tried to operate a foundry of his own. Is this not because it is one thing to be a competent mechanic and another to amount to anything as a business man? Is it not because there is something needed besides good workmanship?

* * * * * * *

All kinds of people take a hand at running foundries. I once knew a preacher and a woodturner who pooled their issues and started a foundry. They busted up. I learned afterwards that the woodturner never amounted to anything at his own business and the preacher had only been able to earn twelve dollars a month, which would tend to show that he was not worth much at his trade either, and some people even went so far as to say that this was exactly twelve dollars more than he earned. These people would have busted, if they had started a bank.

* * * * * * *

Then we have the foundryman who is always asking questions, never stops to do any experimenting for himself or in any other way tries to earn his information. He is always willing to talk somebody into telling him something new. If he secures a new job, he expects somebody to advance enough talk to enable him to turn it out and make a profit. If he only knew that the greater part of the information a man obtains in this manner is impractical, he would not be so anxious to get it. But then we have a whole lot of foundrymen who take delight in telling how things should be done; if somebody else has got to do it. And it might hurt their feelings if they were deprived of the chance to unload their information bureau.

Of course some kind of questions are all right and some again where the questioner would greatly improve himself by answering them personally. One of the most common form of questions, is probably relating to mixtures of iron and other metals. What is the best mixture for such and such castings asks one. Now if he is told to take so many pounds each of scrap, and the different grades of iron, he will feel that he has got something. Tell him the honest truth, that irons vary so much in their composition that such a question can only be answered after experiments and he will feel that you are too mean to tell him anything. Yet in the first case the information is worthless, while in the latter some good is bound to come from solving his own troubles.

Another one will say, tell me what iron will give a certain tensile strength? and if you don't, he will either think, that you do not know much or that you are not as friendly as you might be. Yet the best service that can be rendered such people is to give them a chance to earn the information they are after. There is no royal road to any part of the foundry business, and the best answer which can be given to any question, is only a small percentage of the total information, that must be furnished from the contact with actual experience.

The Value and Use of Aluminum, Manganese and Silicon in the Brass Foundry.*

By F. J. DAVIS.

It is only of late years that aluminum, manganese and silicon have come into use in some of the brass foundries, and in many of them they are still unknown. A greater familiarity with these metals would no doubt prove advantageous and be a source of profit to many of the foundries.

So much has already been written regarding aluminum and aluminum bronze that most of the brass foundries are familiar with the pure metal and one or two of the alloys. Some of them, after two or three failures to obtain a good casting of the bronze have discarded the metal in disgust. Copper, with the addition of from 10 to 11 per cent. of aluminum, is undoubtedly the strongest metal known, also one of the most difficult to cast. This difficulty is due to the great shrinkage of the metal and to the fact that a thin film of aluminum oxide forms on the surface of the molten bronze when it is exposed to the air, and shows up in the casting as so much dirt or dross. The shrinkage can be overcome by providing risers or feeding heads for the heavy parts of a casting, but the trouble arising from the oxide is not so easily overcome. If the bronze is poured from the lip of an open crucible the oxide can be seen entering the mold, appearing as a skin on the surface of the stream, and becomes entangled with the metal in the mold, with the result above stated. The presence of the oxide in the casting does not seem to affect the strength of the metal, but when the casting is used for hydraulic work or under steam pressure it will be found to leak wherever the surface shows the oxide or dross. Casting the bronze from a secondary pot set over the mold, drawing the metal from the bottom of same, will prevent the oxide entering the mold to any great extent, and some very large and perfect castings have been made by that method. The hole in the bottom of secondary pot should be about one inch in diameter for large castings, with an iron plug fitting same perfectly tight. The bronze after being poured from the crucible into secondary pot should be allowed to stand a short time before pulling the plug, which permits the dross in the bronze to come to the surface, only clean metal entering the mold. This plan works perfectly for casting billets and bars for wire drawing and rolling into sheet. Iron molds should be used for this purpose, they should be perfectly clean and heated nearly red hot before the metal is allowed to enter. No wash is necessary or advisable.

A great many castings sold as aluminum bronze are in reality ordinary brass containing perhaps one-half or one per cent. of aluminum. While the addition of this amount of aluminum to brass greatly increases the strength, hardness and fluidity of the metal, it is not true of aluminum bronze, which is the two part alloy of copper and aluminum, varying in composition from 2 per cent. to 11 per cent. of aluminum; 11½

* Paper read before the Convention of The American Foundrymen's Association, Detroit, May, 1897.

per cent. of aluminum in copper is about the limit, beyond that the alloy is brittle. The strongest grade of the bronze contains 11 per cent. of aluminum, and has a tensile strength of from 80,000 to 90,000 pounds per sq. inch, with a high elastic limit; it is not, however, very ductile, a test bar showing only about 5 per cent. elongation in one inch. The presence of silicon in the bronze increases its strength and hardness, but decreases its ductility. An alloy of 3.50 per cent. aluminum, 33⅓ per cent. zinc and balance copper makes the best and strongest grade of aluminum brass. It has a tensile strength of from 75,000 pounds to 85,000 pounds per square inch and is, of course, considerably cheaper than the 10 per cent. aluminum bronze.

Silicon.—As a flux or reducing agent to the oxide of copper that is produced when copper is in a molten condition, silicon is more active in clarifying, refining and strengthening copper, and its alloys of brass or bronze, than aluminum or phosphorous. It has been found upon experiment that the addition of only one-tenth of 1 per cent. of silicon to melted copper before pouring will make the bath more fluid, removes the oxide of copper, makes the castings clean and solid and entirely free from blow-holes. By the use of silicon in this manner, difficult and complicated castings can be made from pure lake or electrolytic copper. Where difficulty is experienced in obtaining solid castings from some of the brass and tin bronze mixtures, the addition of a very small amount of silicon will remedy the difficulty. In the two-part alloys of silicon and copper, 1 per cent. of silicon will go as far as 2 per cent. of aluminum in hardening and stiffening copper, that is, an alloy of 95 per cent. copper and 5 per cent. silicon known as silicon bronze is as hard and stiff as an alloy of 90 per cent. copper and 10 per cent. aluminum, and while perhaps silicon bronze will not resist corrosion as well as aluminum bronze, it is a much better casting metal. It is also valuable for castings subjected to steam or water pressure, as it is a very dense and close-grained metal. The 5 per cent. silicon bronze has also been used very successfully for casting large vats in which a solution of caustic soda is used, the metal resisting the action of the caustic soda much better than any of several other metals tested. The most useful of the silicon bronzes are the 3 per cent. (97 per cent. copper, 3 per cent. silicon) and the 5 per cent. (95 per cent. copper, 5 per cent. silicon), although the hardness and strength of the alloy can be increased or decreased at will by increasing or decreasing the percentage of contained silicon. A 3 per cent. silicon bronze has a tensile strength, in a casting, of about 55,000 pounds per square inch and from 50 to 60 per cent. ductility; it is valuable where a tough and ductile metal is required.

The 5 per cent. silicon bronze has a tensile strength of about 75,000 pounds per square inch and about 8 per cent. ductility, making a very strong and tough metal. More than 5 or 5½ per cent. of silicon in copper makes a brittle alloy. In using silicon, either as a flux or for making silicon bronze, the rich alloy of silicon and copper which is now on the market should be used. It should be free from iron and other metals if the best results are to be obtained. Ferro silicon is not suitable for use in copper or bronze mixtures.

Manganese Bronze.—In much of the manganese bronze used by foundrymen in this country the manganese is added in the shape of ferro manganese, which necessarily introduces considerable iron into the bronze. There is no doubt that this iron is injurious, and that the bronze so made is much more readily corroded and not nearly so strong, tough and ductile as bronze that does not contain iron. A rich alloy of manganese and copper, containing no iron or other impurities, is now on the market, and by using this alloy a very pure manganese bronze of any desired grade can be produced. One of the best and cheapest bronzes can be made after the following formula:

Copper	53.00 per cent.
Zinz	42.00 per cent.
Manganese	3.75 per cent.
Aluminum	1.25 per cent.

This makes a very strong, tough metal, suitable for propeller wheels, gears and pinions, mining machinery, etc. As the bronze contains no iron, a much greater quanity of zinc can be added than when ferro manganese is used, without danger of making the metal brittle. In the above mixture it is quite important that the aluminum be pres-

ent, as without it difficulty will be experienced in obtaining solid castings; in fact it is necessary to add a small amount of aluminum to all the manganese bronzes, as without it they will not cast solid, but no trouble is experienced in obtaining solid castings when a small amount is used. Manganese bronze in the form of sheets is used quite extensively for mining screens, as the acid mine waters have no action on it. For rolling into sheets, a mixture containing more copper and manganese and less zinc is used.

A substitute for german silver can be made by the use of manganese, the different metals and their proportions being as follows:

Copper	67.25 per cent.
Manganese	18.50 per cent.
Zinc	13.00 per cent.
Aluminum	1.25 per cent.

The color of this metal is very good, resembling german silver closely. It is fully as strong as the best german silver and has superior casting qualities, which will be appreciated by foundrymen who have experienced some of the difficulties in casting german silver. It does not corrode as readily as either german or nickel silver. A test of the electrical resistance of this metal shows its resistance to be nearly four times greater than that of german silver, and is therefore a matter of importance where a metal of very high electrical resistance is required.

Oil Furnaces.

Where crude oil for fuel can be had at a reasonable cost, as it can in many of our manufacturing centers, its utility, even at the same cost as other fuels, makes its many virtues so apparent that it is hardly ever dispensed with when once tried.

At the Juniata shops of the Pennsylvania railroad, the master mechanic, Mr. T. R. Browne, has in operation a furnace of his own design which was specially constructed for the purpose of melting bronze for casting hub liners on driving wheel centers for locomotives. The furnace is so arranged that, by means of a separate brick top, which is removable, leaving the whole top of the furnace open, a lead pot can be put in place and used for melting lead for pouring counterbalances. There has also been melted in this furnace steel scrap for the purpose of making small steel castings, though this was done merely as an experiment to determine whether sufficient heat could be generated for this purpose.

FIG. 1.

The burner, for which a patent has recently been granted Mr. Browne, uses compressed air for spraying the oil. The crucibles used in connection with this furnace hold about seventy pounds of metal, and the average time occupied in melting this is one

FIG. 2.

hour, showing a decided gain in time over melting with coke. The burner will consume from three to ten gallons of oil per hour according to the amount of metal to be melted and the extent to which the furnace is forced. The air pressure required to operate it is from twenty-five to forty pounds.

In the case of the furnace, which we illustrate, it is located in the erecting shop, where there are no system of oil pipes, but the feeding of the oil is secured by means of air pressure. The oil is contained in a small tank, which rests on the floor and a pipe connecting with the top of this tank, running nearly to the bottom, forms the outlet for the

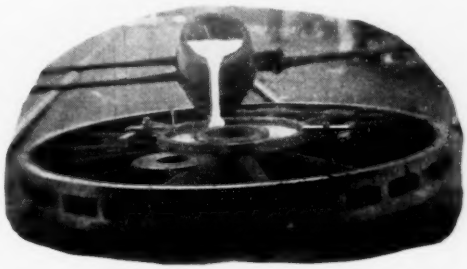

FIG. 3.

oil, carrying it to the burner. The air is admitted on top of the oil, the pressure averaging about ten pounds.

In our illustrations, Fig. 1 shows the furnace with the crucible ready to be placed therein; Fig. 2 the furnace as it looks in operation, and Fig. 3 the general arrangement for casting hub liners.

Correspondence.

Editor "The Foundry":

I was greatly interested in reading in the September Foundry the paper on "Foundry Facings," by Mr. H. F. Frohman, as read at the July meeting of the Western Foundrymen's Association, and on the discussion of same by several well-known foundrymen; but I was especially so on some of Mr. Rowland's remarks on charcoal facing, and also the fine light castings he had seen in Dubuque, Iowa. He stated that his attention was called to them in that city, and that they made the finest light castings he had ever seen in his life, etc.

Now as there are several foundries in Dubuque, and he has not mentioned the name of the one making those fine castings, I think it is no more than just that due credit should be given to the right one. The foundry Mr. Rowland has referred to, that of the Adams Co., has the reputation of making the finest light castings west of the Mississippi river, and perhaps as good as can be made anywhere in the country, and I honestly believe that their success is partly due to the use of charcoal facing.

However, there is nothing new in the use of charcoal as described by Mr. Rowland. The writer has used the same over twenty-five years ago, and no doubt others have used it long before him. One thing certain is that it is not generally known and could be used to good advantage in all foundries making light castings, especially in making fine ornamental work and shelf hardware.

The grade used for this purpose is ground somewhat coarser than that used for returning, and is supposed to be pure. A little of this facing shook on the pattern will produce castings true to pattern and will save nearly half the time in milling, without wearing the corners off the castings. It also helps materially in doing good japanning, bronzing, nickel-plating and coppering.

Some three years ago I happened to drop into a foundry near Chicago, which has the reputation of making very fine light castings. The foreman, a first-class man, too, called my attention to some very delicate castings that he had to make, and stated that he had lots of trouble with them and could not make them nice enough. I suggested that he try charcoal. He did so and was amazed at the results. He thanked me for the "pointer" and stated that he would never be out of charcoal in the future, and no doubt he has used many barrels since. I do not want the readers of The Foundry to understand that I mean that good castings cannot be made without facings. On the contrary, on some class of work they are only an expense, but on others they are an absolute necessity. Of course it is necessary to use judgment on everything. Charcoal may be more costly than ordinary bag facing, but if the quality of the castings are to be taken in consideration, it is by far the cheapest to use on light work. I think it will be a long time before the foundrymen of this country will be able to dispense with facing in general. HAWKEYE.

Cost sheets and estimates often include human lives, but they rarely appear in the yearly report.

Philadelphia Foundrymen's Association.

The regular monthly meeting of the Foundrymen's Association was held at the Manufacturers' Club in Philadelphia on Wednesday, October 6, the president, P. D. Wanner, occupying the chair. There was a fairly large attendance of members.

The report of the Executive Committee for the month just passed showed little or no change in the condition of the foundry trade.

THE DEFENSE ASSOCIATION.

W. H. Pfahler, of the Abram Cox Stove Company, Philadelphia, chairman of the Committee on Defense appointed at the convention of the National Foundrymen's Association recently held at Detroit, by invitation then addressed the gathering in regard to the progress made by his committee. He said: "Acting under the instructions of the convention the committee appointed to canvass the matter have been in correspondence with a large number of manufacturers, nearly all of whom they found evinced a desire to take up the subject and work out the problem of defense. There seems to be no doubt in the minds of those we have corresponded with as to the advisability, and little doubt as to the practicability of the formation of a defense association. I called a meeting of the committee here about two months ago, and after a two days' session we believe we reached a line of formation which will be acceptable to the foundrymen. We at once commenced correspondence with about 200 of the leading foundrymen of the country, selected at random, asking them if they were sufficiently interested in the matter to attend a meeting for a discussion of the subject. Although that invitation to a discussion has only been out about ten days, we have already over 100 acceptances. I have, therefore, called a meeting, to be held in Cincinnati at the time of the meeting of the Western Foundrymen's Association the week after next, which will get those founders located west of Ohio to attend, and in November we expect to have a meeting in the east. Between those two meetings we have little doubt but what we can formulate a plan which will be acceptable. It is the purpose of the committee after those two meetings to have a general meeting for the purpose of adopting by-laws and putting the association in working shape. I found in New England, especially, where there was formerly a great aversion to anything of the kind, the strongest advocates to-day in favor of an organization which will be counter to the organization of the employes, and the idea that such an organization as the former must be antagonistic is dying out, because to-day the warmest advocates in its favor are to be found among the laboring men themselves. They realize that in an organization such as contemplated they will have a strength against agitation and the agitators who are in the minority always in the labor columns. There is not 20 per cent of the Molder's Union to-day who are in favor of a strike, and yet that small percentage could bring about a strike. With the manufacturers organized they will have a support which is always maintained. The committee are very much encouraged with the work that has gone on so far, and I hope after the meeting in Cincinnati to be able to report a great deal of progress."

W. C. Henderson then read the following paper on

"THE CONVERSION OF WHITE IRON CASTINGS INTO STEEL."

The production of steel castings, the result of molding liquid steel, is fraught with difficulties of a persistently dominant nature. For instance, green sand may not be used for a mold into which it is intended to introduce melted steel, because the water in the sand chills the metal at the gates and so prevents its running. No better success will be obtained by employing a dry mold of ordinary sand, because the fluid steel is at a higher temperature than the fusing point of the mold. With a dry sand mold, faced with a substance requiring a greater heat to become melted than that possessed by the entering metal, some success has been obtained, though by no means entirely satisfactory, even in casting very large thick shapes.

Steel is only held fluid with great difficulty, owing to its excessively high melting point, and upon entering a mold several thousand degrees cooler the metal immediately in contact with the walls of the mold becomes solid and fixed beyond the possibility of yielding to the subsequent contraction

which steadily takes place as the mass cools. Unless a liquid connection is maintained between the center of the casting and the source of supply until the metal has become solid throughout, the casting will be defective through internal shrinkage.

Supposing all of these details to have been carefully worked out and provided for, there still remains the most serious difficulty of them all—namely, the prevention of the occlusion of gases, which convert the result of the operation into a molded steel sponge.

An exceedingly attractive and seemingly hopeful procedure toward the surmounting of these obstacles lies in the converse efforts to bring the metal conditions to suit the mold, instead of striving to wholly adapt the mold to the metal. The "Terre-noire" and the "Mitis" processes may be taken as illustrative of what has been attempted in this direction. It was hoped (and not entirely in vain) that the addition of silicon, in the one instance, and aluminum, in the other, would effectually prevent the occlusion of gases, and at the same time so lower the fusing temperature of the steel that it could be readily melted.

Where it is desired, however, to obtain castings of intricate shapes and small dimensions, so much has been left desired in the application of these direct methods that in order to meet the demands for castings of this class considerable metallurgical license has been indulged in, in the more or less successful operation of purifying and converting castings, primarily made of white pig iron, into steel, by first extracting all of the carbon, as in the case of malleable iron, and next introducing an amount of carbon by a cementation process.

Small castings, by courtesy called steel, are at present almost entirely made by this process, and are giving fair satisfaction in some cases. Some of the manifest drawbacks to this method are the length of time necessary for the operation (requiring a period of not less than three weeks), the inability to control the amount of carbon introduced during the second part of the process, and, finally, the total failure to have removed from the castings any of the sulphur, phosphorus, silicon, manganese, arsenic, etc., which were, of course, present in comparatively large proportions in the white pig iron from which the castings were originally made.

The process operated by the New England Steel Casting Company, Philadelphia, occupies a place, as nearly as I am in a position to judge, not knowing of what the process consists—it being a secret one—just between the white iron method as now practiced and the doctored steel. Castings are made in green sand, and have the appearance of being white iron. They are submitted to a converting process, which extends over a period of from two to six days (dependent upon the size of the castings treated). It is claimed by the owners of this process that the castings produced by them are fairly free from the objectionable metalloids; have combined carbon in any desired percentage (no graphitic carbon whatever); have a tensile strength of 70,000 pounds and upward, according to the carbon content; will bend and draw out cold after the manner of wrought iron; will temper, weld, and take a high polish.

DISCUSSION.

Mr. Evans: Is it possible to make castings of any size larger than the samples we have here before us? I hardly suppose it would be possible to make cylinders for locomotives or bed plates for engines. There must be a limit somewhere. What is the limit?

Mr. Henderson: I believe the company propose to make a specialty of small castings, taking them up where the other processes drop them, 6 inches downward. Where the Mitis process can be used it is, I believe, cheaper than this process.

Mr. Devlin: Do you know whether it is possible to make a casting of that character any more solid than you would a casting of the same character in malleable iron?

Mr. Henderson: I believe it is claimed that they do that; but I know of no reason why malleable iron could not be made as solid.

Mr. Flagg: Mr. Henderson said the castings required a treatment covering in some cases two days, in others as long as six days. How would it be arranged that one casting should get two days and another six days? Would they classify the castings or have separate ovens?

Mr. Henderson: I believe they contemplate doing both. They classify the castings at

present. They intend to have a soaking pit in connection with the process, and take castings out during any stage of the operation.

Mr. Rominger: What would be the expense compared with malleable iron?

Mr. Henderson: It would be cheaper.

Mr. Outerbridge: Have you made an analysis?

Mr. Henderson: Incompletely only.

Mr. Outerbridge: Of course, I know you are familiar with quite a number of processes for converting iron into steel. Some of them have been before this Association. We have seen axes and various small castings precisely similar made with white iron originally. All these processes start necessarily with white iron, which is about the same specific gravity as steel. It is conceivable that there might be a process for oxidizing out the excess of combined carbon in practically a small section. We remember that a Mr. Bates some years ago had a process advertised quite extensively, and many people invested large sums of money, went in on the ground floor and came out in the attic. I do not mean to intimate that there is any relation between that process and the one before us. A year or two ago Dr. Hunter was before us and exhibited a number of castings similarly treated; and I believe a modification of his process is in use in a foundry in Frankfort, Pennsylvania, to-day. I should like to ask Mr. Henderson whether this process is a new process, or whether it is analogous to any of the other processes with which he is familiar, and whether the result is superior and cheaper.

Mr. Henderson: I have been called upon professionally to investigate most of all of these processes. I have not been able to investigate this process fully; but in such experiments as I have made I have found no carbon at all. There is no graphitic carbon at all.

Mr. Devlin: As I understand it, you have only as yet examined small, thin castings. From your experience in analyzing thin malleable castings have you found them to contain graphitic and combined carbon, or not?

Mr. Henderson: In some instances I have found considerable graphitic carbon. In fact, some malleable-iron people told me, when on a visit to Chicago last week, that it would be impossible to have malleable iron castings without graphitic carbon. Some castings I know to be entirely free from graphitic carbon, and also practically free from any trace of combined carbon.

Mr. Outerbridge: Does not that depend upon whether they start with pure white iron?

Mr. Henderson: There is one point I picked up in Chicago that struck me as rather singular. It is the custom there to use brick-dust, ashes, sand, or anything of that nature, and they really effect the change from the combined to the graphitic state. As regards the malleable iron, all I saw contained only 2 per cent graphitic carbon; but they make no attempt to eliminate the carbon.

Mr. Evans: Are the owners of the process ready to take orders commercially?

Mr. Henderson: Yes; they have a plant in operation; it is not very large at present; but they are doing the work.

Mr. Outerbridge: How large a section can they convert?

Mr. Henderson: I have not seen anything over two inches.

CAST IRON NOTES.

Devoted to Inquiries from Practical Foundrymen on the subject of Melting and using Cast Iron. Address all Inquiries to W. J. KEEP, care of The Foundry.

WHAT ARE THE MOST SUITABLE IRON MIXTURES OF CAST IRON FOR LARGE MAGNETS?

Probably this relates to the frames and fields of dynamos. The best material would be soft steel, and manufacturers are using steel castings. The next best thing is to make the frame of cast iron, and bolt to this blocks of soft steel which are cast.

But the question is, Which cast iron mixture is best? There is great diversity of opinion regarding this, but the softest iron seems best. From the fact that soft steel is acknowledged to be the best material, it would seem that a casting having the least proportion of metalloids and the greatest percentage of iron would be best, but it must contain sufficient silicon to insure the least possible combined carbon. A good Bessemer

pig should give the best results. The total carbon must be taken as it comes, and it will probably be about 3 per cent. If ordinary irons are to be used, add enough silicon to make soft castings, but not enough to prevent them being solid.

DOES MORE THAN THREE PER CENT. OF SILICON MAKE A HARD CASTING?

I am using a mixture that turns out very soft castings, which shows by analysis:

Graphitic carbon	3.50
Combined carbon	.30
Silicon	3.75
Phosphorus	.80
Sulphur	.05

What I want to know is, do the other elements in the iron make up for the excess of silicon so as to make the iron soft?

It is not possible to tell from a chemical analysis what the exact physical character of a casting is, but it gives an idea. The carbon is higher than is ordinary for pig iron from furnaces which are driven rapidly. The questioner does not tell the kind of castings which are made from this iron. With this amount of carbon such iron would be suitable for very thin and delicate castings. With silicon about 3.50 per cent, thin castings are made with a very smooth and delicate surface. The color of the surface is quite silvery, and the iron does not burn the sand. Such iron will stand fire much better than if made with less silicon, and will resist the action of fire, and is for these reasons well suited for stoves.

For light ornamental or hardware castings such an iron would give the best results. It would make such castings very strong and fine grained, but if made one-half inch thick the grain would be quite open, and it might not be strong; and the mixture would make a spongy casting if the thickness was one inch.

I generally say that up to 3.50 per cent silicon softens. The reason for this is that a higher percentage is seldom found in the castings, and because a higher percentage often hardens. For light castings when carbon is under 3 per cent. silicon is often run up to 4 per cent with the best results. A mixture is expensive with silicon higher than 3.50 per cent.

For machinery castings we use 25 per cent of above iron, 25 per cent pig iron, the analysis of which is:

Graphitic carbon	3.55
Combined carbon	.45
Silicon	2.25
Phosphorus	.50
Sulphur	.035

and 50 per cent good machinery scrap.

This mixture is very satisfactory except it shrinks very much on the top of the hub of pulley wheels, etc.; we also find holes in places where one part is heavier than another. Could you tell what would help this?

The carbon in the pig iron is higher than in the other iron of which an analysis is given. The higher the carbon the less silicon is needed. The trouble is that the irons used are too good. If the machinery scrap was close grained instead of "good," and if the second pig iron was No. 3, with 1.75 silicon, there would be less shrinkage on the top of hubs. This internal shrinkage is caused by the iron remaining fluid at the center after the exterior is solid, which allows the plastic top of the casting to settle of its own weight as the fluid iron decreases in bulk on account of a reduction of temperature. Reducing the silicon causes the interior of the casting to set quicker.

It would be well to use the cast-iron borings from your machine shop packed in boxes made of one-inch pine. Make the boxes of a size to hold 100 pounds of borings, and nail the cover on. Charge the box along with the pig iron, using 100 pounds of borings to each 1,000 pounds of all other irons, including foundry scrap. If this does not prevent porous castings, use 200 pounds of borings to each 1,000 pounds.

Why Does a Chilled Roll Crack in Cooling?

By C. F. LOGAN.

Being employed as a roll molder for many years, I have frequently noticed that this occurs without anyone knowing the reason therefor. A practical chemist is employed in our foundry for mixing iron, which is melted in a reverberating furnace, and he also attends to the casting of the rolls.

One day we cast a roll "32x120" and the following morning found that the roll had

cracked the entire length of lower chill (60 inches, the chill being in two sections), although there was no crack visible in the part formed by the upper chill. The frequent occurrence of cracked rolls has been explained by the chemist to be due to "too strong iron," or "iron having too great a shrinkage," and being in doubt as to the truth of this explanation, causes me to ask these questions.

Another peculiar incident which I have noticed in this connection is that we may cast five rolls from the same ladle of iron, the molds being placed in a pit alongside of one another and cast in rotation, and often the middle roll will crack, causing me to doubt our chemist's opinion concerning the actual reason for such loss. I have asked others to explain the phenomenon and one said that while he had been unable to locate the exact cause, he had observed that there was a great loss when the iron was poured at a low temperature, while others claimed cracking was due to a directly opposite theory. The majority seemed to regard it as an unsolved mystery.

I also interviewed the foreman of a roll foundry, who held an entirely different opinion. He claimed, something that was new to me, that the cracking of rolls is due to the chill and not to the iron. I asked him what effect a chill could have that would cause the cracking when all chills are treated alike and prepared according to a uniform system. This seemed to interest him, as he smiled and said: "My boy, you are after information; don't you know that the making of chilled rolls is considered a secret?" I begged him to explain how it could be due to the chill, and after a long persuasion on my part, he said that the irregularity or non-uniformity of chill as well as the cracking of the roll itself was due to the treatment of the chill.

He continued: "In foundries where rolls are made, very little attention, if any, is paid to the chill. This neglect has caused trouble for the man who mixed the iron. In nearly all foundries skilled molders are employed for making the molds, but not so in putting together or preparing the chills, where common laborers are detailed to do this important work. The laborer after being instructed does his work all right the first day, not so good to-morrow and very indifferent the next day, and the consequence is irregular chill and cracked rolls. Sometimes the blacking which he applies to the inner surface of the chill is not fit for use on cores even. Again he may give one side of the chill an extra coat or two, because he does not know any better. If the iron adheres to the chill, or a roll happens to crack, we hear the old adage about hot iron and excessive shrinkage. This theory I long ago discarded for more practical ideas. If one of our rolls cracks, which very seldom happens, it has always been caused by the chill itself, or by not succeeding in treating a new chill properly, comparing to an old chill which has been in long use. This, with many other small points concerning the chill, which I myself blacken and thoroughly examine before casting, together with a carefully kept record, has proved to me that the cracking of the rolls is due to the chill and not to the mixture of iron, its temperature, or any other theory concerning the metal."

Can anyone add further to my fund of knowledge on this subject, or tell me which of these opinions is right?

Chilled Gears.

It is a well-known fact that the majority of gear wheels cast in sand are not as exact in pitch and size of teeth as originally calculated. Especially is this so where wooden

pattern are used, when the mold sags more or less in being turned over and rapping slightly deprives the teeth of their intended form.

We illustrate herewith a chilled gear made by the Gear Wheel Mfg. Co., of New Castle, Pa. In molding and chilling the teeth, a segmental ring, made up of as many segments as there are teeth in the wheel is used. These chills are set within an iron ring, turned out to an exact circle, and fitted to an iron pattern made without draft. The accuracy of the chills is proved, by shifting the pattern to different positions without affecting or disturbing the position of the chills.

As shown in the illustration, it is only the wearing surface of the teeth which is chilled, the main body of the casting remaining soft to permit of finishing. These gears have given excellent satisfaction for street car motors where the service is unusually severe.

The Tabor Improved Molding Machine.

Our readers are acquainted with the earlier forms of the Tabor Molding machine, through illustrations and descriptions which have appeared in our columns. Among the latest improvements made in these machines is the substitution of air for steam as an operating power. While the latter is useful, it can not be gainsaid that in molding air furnishes a medium which may be used in more ways than steam. This is noted in the last model, where dust and sand are removed from the pattern by simply pointing a hose at it, instead of the former slow and ineffective way of removing such by a brush, wielded by hand.

In its present form the machine is self-contained and no part of it extends below the floor level. The manufacturers have realized that the expensive drawback to molding machines, known as the stripping plate, could in many cases be obviated if a suitable rapping mechanism could be applied, and

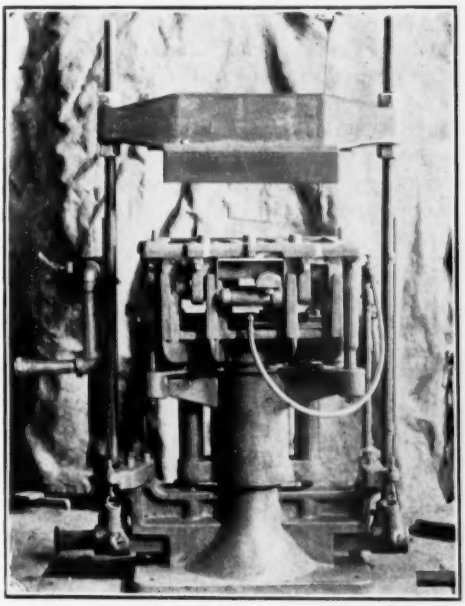

FIG. 1.

FIG. 2.

such a device is attached to their last model, a rear view of which is shown in Fig. 1. The vibrating produced by this pneumatic rapper is more perfect than could be administered by hand, and consists of a great number of small shocks, while rapping by hand is usually composed of a small number of heavy shocks, which materially disturb the outlines of the mold, an effect entirely unnoticed by this device.

Our second illustration shows some samples of work made on this machine, and speaks more eloquently than words for its practicability. The ornamental casting patterns is much less and the facility with which these may be changed much greater than with the earlier stripping plate machine. The system of fitting the patterns on the plates, as practised by the manufacturers, permits either wood or metal patterns to be used and ensures absolute accuracy.

For patterns having deep vertical draft, or wherever there is a tendency to tear the mold "stools" are provided which follow the upward movement of the flask and remain in contact with the lower surface of the sand until the vertical part of the mold is clear of all obstructions.

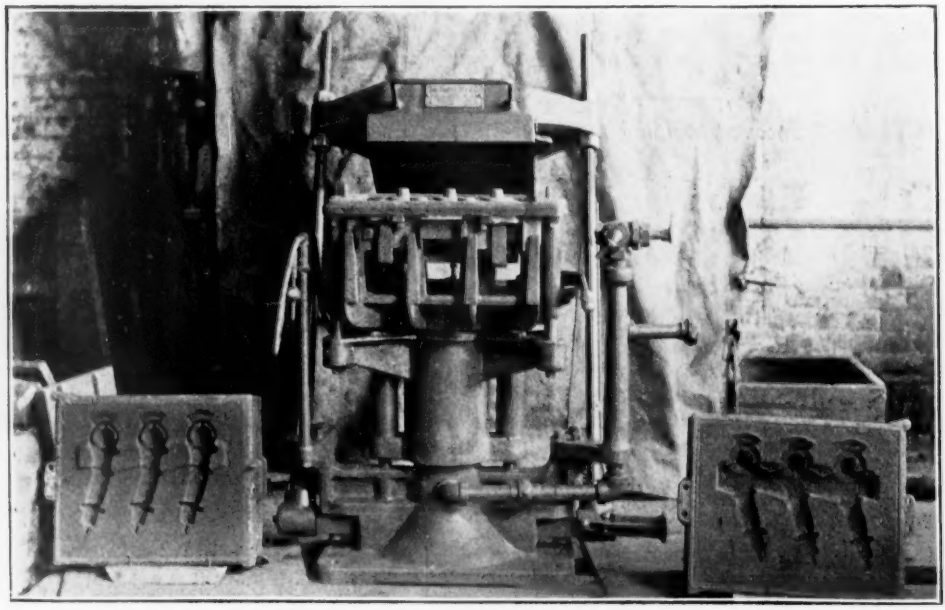

FIG. 3.

shown has been "returned" or printed back in order to obtain a smooth face. This is an unusual operation in connection with machine molding, but it is claimed that there is nothing to prevent this in the present form of the machine.

The uniformity of hardness in ramming may with this machine be adjusted to suit individual preferments. When once fitted up with a set of patterns, a change from one kind of casting to another can be made in incredibly short time. To those acquainted with the earlier forms of this machine it may be necessary to say that the cost for

Fig. 3 is a front view of the machine, showing the position of the pattern when the mold is lifted off.

The Tabor Mfg. Co., Elizabeth, N. J., are the manufacturers.

Pokey's Pointers.

Potiphar Pokey, president, secretary, treasurer and grand vizier of Pokey's foundry, has been doing some thinking not strictly in accord with the golden rule. His foreman, Tom Bowers, has been drawing too much of a salary to suit him and Pokey has come to the conclusion that part of this

money could just as well remain in his own pockets.

Now, when you want to cut down your men, the common everyday scrubs, I mean, you just have your typewriter decorate about a square foot of your stationery with characters to the effect that after a certain date you intend to do so and so. If you are a philanthropist and believe in sugar-coating things, an excuse or two will make the document more formidable and something you can be proud of in a literary way. The more of such notices you can paste over the biggest cracks in the largest door of your shop the more free advertising will you get. The free silver crowd is keeping a close eye on such items since we went on a sound money basis.

But when it comes to reducing the stipend of your foreman that is a horse of a different color. More than once Pokey has been pulling his hair to induce a faster circulation of the blood in his apex and enable him to get around the problem. Pokey knew he was engaged in a job of more than ordinary meanness, and did not feel like showing his hand more than he had to.

The whole trouble was started by Nick Yahoo, the one-horse foundryman of Big Bend, whispering to Pokey that he had a peach of a foreman, who not only ran the shop but put up the biggest day's work himself for two and a half a day. Now here was Tom, apparently not doing a darned thing. Then Pokey heard reports from Texas, Boston, Chicago and a few other places that have not been Americanized yet to the effect that high-priced foundry foremen were being let out and cheaper help substituted. Lastly, Jim Muggins, Pokey's superintendent, who wags his ears whenever his boss happens to sneeze, and who is only getting twelve hundred a year while Tom is getting fifteen, suggested that there were plenty of men in Grand Rapids, Mich., willing to take charge of foundries for the glory there was in it and two dollars a day, and they would be happy to work like h— in the bargain.

With this information to back him up, Pokey hied himself out to the foundry, where he started his conversation by dishing up some of the last season's campaign hash.

"Money goes further nowadays, don't it Tom?"

"Yes, to most people it goes so far that it can't be seen."

"What I was thinking, ahem, was that we have reduced the men without taking any notice of ourselves, and I thought that since prices don't seem to pick up any we would all have to stand a little reduction. You know the Enterprise cut their foreman to seventy-five dollars a month," added Pokey, to kind of justify his own suggestions.

"I heard of that," said Tom, who had by this time divined the old man's intentions, "Times are getting to be so that the only show there is for a competent man to secure decent wages is to lay around until a shop runs down so that it seems like the devil himself couldn't straighten it out. Then he will be paid for putting it into shape again. The whole thing is something like this: A man comes along here and does some tricks, and you plank down a dollar or two and vote him to be a smart one. Let him show you how the trick is done and you turn right around and call him a blamed fool. The same way with the foundry business, after you see how it is done, you begin to think that it is nothing worth paying for."

"There is something in what you say, Tom," answered Pokey, "but there is the Crooked Radiator Co. After they got things agoing and Wilson got their rigging finished, they let him out and put in a cheaper man to drive their Polacks. Now will you tell me where they have lost anything by doing so?"

"Well, Wilson was smart enough to learn them one trick, and I think if he had stayed there he would have learned them some more before this. It is all right to fire your high-priced men if you are sure you won't need them any more. But new tricks turn up continually, and old ones are improved upon. It is no trouble to get foremen to follow an established practice, that is clear as mud, but when it comes to getting up something new a cheap foreman does not always pay."

"Nick tells me he has got a beauty for two and a half, setting a hot pace for the whole outfit. How do you account for that, Tom?"

"If you were not so ignorant, so blasted honest ignorant, as you appear to be, I

wouldn't answer you," said Tom. "What do you hire a foreman for anynow? For the work he does or for what he gets others to do? Here you slab-sided Yankees come out in the foundry and expect a foreman to pull off his coat and pitch in. What do you do in the machine shop? If Muggins should go to work and let the men look after themselves you would kick him out, and you know it. You keep a foreman in your machine shop to get up jigs and contrivances for cheapening work. Why change your philosophy the minute you come over here? Now, coming back to Nick Yahoo and his 999 foreman, he hasn't made more money so far than he knows what to do with, has he?"

"Guess not," remarked Pokey.

"Maybe you don't believe a man can move like there was a piece of hot iron in his trousers, and yet do nothing?"

"Talking about Yankees, you are beginning to ask questions."

"That is the way to settle an argument. Now, I will tell you, Mr. Pokey, what your idea of a foundry foreman is. You think that when he comes into a shop in the morning the first thing he does is to say: 'Here, Bill, take this. Make ten. Hunt up a flask. See that that dumb ass of a coremaker gets the cores ready. Here, Jim, take this. There is forty wanted. See the blacksmith about cutting off those pieces of wrought iron.' Now, this is your idea of what a foreman does. After he gives each man a little lecture, you believe he does nothing but wear out the seat of his pants till it is time to figure up the heat. And you are right. That is what some of them do: mostly those cheap ones, too. But they ain't foremen, are they? Any old woman could sling a few patterns out, and if she remembered the least part of her arithmetic, she could figure up the heat, too. It is what you don't see a foreman do that counts."

"There is the Olympia; got their foreman to take the shop by the ton. How would you like that arrangement?" asked Pokey.

"No gambling for me," answered Tom. "If things are not going all right as they are, they are not going to move along better because you change it over to tonnage. I would either beat you, or you would beat me. Why don't you let Muggins run your machine shop by the ton?"

"That is different, don't you know that? I must be going. Will see you in a day or two." And as Pokey trotted out he mumbled to himself: "That blamed cuss of a Tom, he wants to know too much."

The Doherty Process of Iron Founding.

By N. T. ARNOLD.

Observing foundrymen have noticed for years that iron would melt more freely and that a hotter iron could be obtained when the atmosphere was impregnated with moisture, than during a period of hot and dry weather. This led some to introduce moisture into the air blast when the atmospheric conditions were of such a nature as to render melting most difficult; and this was sometimes done by saturating a sheet or blanket with water and hanging it back of the fan, causing water to be thrown on the sheet from time to time as the melting progressed, so as to renew the supply of moisture. This proved helpful under certain conditions, but those who resorted to this expedient were satisfied to aid nature without seeking for the scientific explanation of the phenomenon. Others, who had noted that a humid atmosphere expedited melting, conceived the idea of introducing steam into the cupola along with the air blast, but as the operator with the wet blanket obtained too little moisture, the other usually got too much, and though some continued to use steam for a time, its use was invariably abandoned because results attained were not sufficiently satisfactory to warrant the additional trouble and cost.

Efforts seem also to have been made to introduce gases into the cupola to aid in melting and reduce the oxide of iron, so that there would be less slag and more iron, but these methods were abandoned because of the expense of generating the gas.

It was seen that water (H^2O) was composed of the very elements needed, hydrogen and oxygen, but how could it be decomposed quickly, positively and cheaply into its component gases? This was the question for solution. Should water come into contact with the fire, the result would be harmful, and as steam is only water raised to a high temperature, steam must be injected, if at all, only when the heat already in the cupola would

be sufficient to disassociate the water, so that the hydrogen and oxygen it contained would add to and not detract from combustion. It would also follow that the amount of steam injected must be no more than could be readily decomposed, else the steam would retard rather than accelerate melting. Neither should less steam be injected than could be disassociated, else the chemical effect produced would be too weak to work any considerable change in the melting mass.

Mr. Thomas Doherty, of Sarnia, Ont., after observing in his foundry some of the phenomena indicated, continued his investigations with the view of determining under what conditions, if any, it might be possible to resolve the steam into its gases by bringing it into direct contact with the melting iron, and to such an extent as would accomplish practical results. His experiments proved to be entirely successful, and something less than two years ago he took out letters patent in the United States and Canada, and has since obtained letters patent in the principal European countries, covering the process of melting cast iron by injecting live steam into the cupola along with the air blast in such quantities as to produce the hydrogen flame, indicating that the disassociation of the water is complete and the gases are free to do their work.

The results are marvelous and we enumerate the principal points, which the inventor makes, with a brief explanation of the principle underlying such claims.

A saving in quality of fuel used is effected as the hydrogen flame is 4.28 times as hot as the ordinary carbon flame, and as oxygen is a strong supporter of combustion the gases obtained from the decomposed water play an important part in melting the iron placed in the cupola, thus effecting a saving in the quantity of fuel required to melt the iron. For the same reason an inferior grade of fuel may be used.

Another reason assigned for use of an inferior grade of fuel is that the impurities contained in such inferior coal or coke are burned out by the intense hydrogen flame, so that they do not enter into the iron to its injury.

The hydrogen flame and intense heat produced by it, and the effect of the liberated oxygen destroy the impurities contained in the lower grades of iron so that the iron is left comparatively pure after being melted in and by these gases. As a result the foundryman may use a lower grade of iron than would otherwise be adapted to his purpose. Again in melting iron there is ordinarily great loss, and particularly so in the use of scrap, from the fact that the rust (oxide of iron) passes off in the slag. Iron rust is, practically, iron going back to the ore state and the heat of the ordinary cupola cannot resmelt this oxide of iron. By the aid of the hydrogen flame and the liberated oxygen, this iron rust is resmelted, converting it into pure iron, so that the loss is reduced to a minimum. Foundrymen often have detected a loss of 30 per cent in melting rusty scrap iron, whereas by the Doherty process it is claimed that the loss is reduced to less than 2 per cent.

In melting in the ordinary cupola the air blast plays an important part, and it is not at all unusual to find that the steam capacity of a plant is much larger than it otherwise need be in order that the fan may be of such size and revolve at such speed as to produce a heavy blast. With the Doherty process the blast is still important, but the gases, obtained from the steam, supply to a great extent what is needed in the cupola, so that so strong a blast as is ordinarily used is not necessary. Besides the melting occurs much more rapidly, requiring less time for the operating of the blast.

It is a laudable ambition on the part of every foundryman to be able to produce smooth and perfect castings, no matter for what purpose they are intended, but not all are successful. Neither is it an easy matter to obtain perfect castings where delicate patterns are to be wrought without using a high grade of iron. By the use of the hydrogen flame the iron is rendered very hot and homogeneous, so that all castings come out in a perfect condition, being very smooth and even. Those who have used the process state that it is exceedingly rare to lose a casting, no matter how ponderous or how delicate it may be.

Where machine work is required, it seems to be the usual practice to make the mixtures of the softest irons possible in order to reduce the expense of working in the machine shop. This necessitates the use of high

grade irons, or of lower grades which may give softness, but which are apt to render the iron weak. Even then a scale or hard surface is formed, which it is difficult to work through. As the hydrogen flame burns out the sulphur and other impurities contained in the iron, the casting is rendered very soft and easily worked, even though a portion of the graphite carbon has been converted into combined carbon, thus rendering the casting much stronger than it otherwise would have been.

The increased tensile strength of the castings produced and their semi-malleability is one of the most remarkable features incident to Mr. Doherty's process of melting. In England, where iron and coke are inferior to the grades used in this country, the tensile strength has been increased as high as 38 per cent. In this country it is a common thing to be able to increase the tensile strength 25 per cent, although the castings are, as before stated, always soft, owing to the fact that the impurities have been burned away. Ordinary stove plate can be punched cold with inch holes not more than one-eighth inch apart and an ordinary test bar may be put in a vise and upset cold to an extent of 25 per cent of its diameter.

These latter tests have been made repeatedly on iron produced from 70 per cent common scrap and 30 per cent No. 2 and No. 3 foundry pig.

The inventor has so thoroughly demonstrated, at his own foundry and at other foundries in England, United States and Canada, the correctness of these several claims, that it only remains for foundrymen to convince themselves by actual experiment of the utility of the process, though it must be remembered that the effects are chemical, and that the conditions of every cupola and mixture must be studied in order to accomplish the object aimed at. The expense of operating the process is so trifling as scarcely to be considered, the amount of steam used being very small, yet the simplest weapons are most effective when manipulated by a skilled hand. Mr. Doherty is at the present time in England where his patents for foreign countries have been sold for a very large sum of money.

A. E. Outerbridge Honored.

The Franklin Institute, through its committee on science and the arts, investigating the merits of Mr. Outerbridge's investigations in the molecular physics of cast iron, has awarded Mr. Outerbridge the John Scott legacy premium and medal, a notable distinction conferred only where absolute originality prevails.

We have from time to time published items referring to this subject and will only quote the following from the committee's report, showing the corroboration of all former statements:

"The principal result has been to largely upset some of the generally held ideas on the subject of cast iron, and where formerly it was considered essential that small or light castings must be protected from shocks, it is now believed that they may be generally strengthened and relieved of their internal cooling strains by judicious treatment in this way.

"Members of the sub-committee have made many experiments similar to Mr. Outerbridge's for transverse strength, and they believe that where the proper conditions are observed there will be a decided gain in strength in almost every case, at times running as high as 35 or 40 per cent increase in the rumbled, over the unrumbled bar. Many others have made similar experiments with the same results, both with high and low silicon irons.

"The fact that a certain molecular change takes place in cast iron in the course of time has long been known and recognized by many persons, and that this change tends to relieve the internal strains and render the casting tougher, has often been noticed and acted on, although in a very crude way, but so far as the sub-committee has been able to learn, Mr. Outerbridge has been the first to make a careful study of this and to note that the change may be hastened by impact, and the whole effect produced in a short time, and also to make a scientific study of the phenomenon."

A Universal Opinion.

THE FOUNDRY is a valuable paper to any energetic foundryman.

L. J. GILLETT,
Council Bluffs, Iowa.

Good Times; Whoop!

Specific statements are more valuable than generalizations. No informed man doubts the vast improvement that has come in the iron and steel industry, but this definite statement by two Youngstown, O., rolling mill companies emphasizes the industrial revival in a way that gives a wonderful stimulus to confidence. The figures are for the first half of the month of September in 1896 and 1897:

	A		B	
	1896	1897	1896	1897
Men employed .	155	900	1,260	2,005
Pay roll $4,697		$21,756	$11,012	$36,304
Product, tons .	463	3,130	1,423	5,920

The figures under A are for the Brown-Bonnell Iron Co., and under B for the Union Iron & Steel Co. It is to be said of other plants in the Mahoning Valley that, like the two mentioned, they have had no such tonnage on their books since the boom of 1895 was at its height.—Exchange.

(Yes, figures are all right when they show what you want them to. Just to show what figures will do we append the following table, wherein the items enumerated above are simply tabulated in a different manner:

	A		B	
	1896	1897	1896	1897
Earnings per man.	$30.30	$24.17	$8.03	$18.10
Cost per ton	10.14	6.95	7.73	6.13
Output a man, tons	2.98	3.47	1.13	2.95

If the Union Iron & Steel Co. had their men working half a month for $8.03 a year ago they certainly show quite an improvement. While the earnings per man have more than doubled with this concern the Brown-Bonnell Iron Co. show the average earnings lessened. The increase in output per man and the reduction in cost per ton show some notable variations. In fact, from a set of figures of this kind there can be manufactured statistics to suit any political party. There is something to be said on both sides, and we fail to find in these numerical calculations anything roseate enough to cause us to blush. Times are better, but the pressure is not high enough to be uncomfortable.—Ed.)

Among the Foundries.

Jno. O'Brien is building a new foundry at Phoenix, N. Y.

H. F. Brook's foundry at Candor, N. Y., burned. Loss unknown.

Stults & Campbell have established a foundry at Carthage, Mo.

The Thomas Brass Co., of Waukegon, Ill., will erect a new foundry.

Davin & McClure have reopened their foundry at Washington, Pa.

The E. P. Allis Co., of Milwaukee, Wis., will erect an additional foundry.

The foundry located at Bliss, N. Y., has been purchased by Norman Cross.

The plant of the Perkins Foundry Co., at Amsterdam, N. Y., is to be enlarged.

The Kingston (Ont.) Foundry & Mach. Co. were visited by a small fire recently.

A foundry and machine shop will be erected at Barnesville, Ga., by James McRae.

The Standard Mfg. Co., of Pittsburg, will establish a brass foundry at Allegheny, Pa.

The Bell & Fyfe Foundry Co., Brooklyn, N. Y., were visited by a small fire recently.

C. Melvy's foundry, 19 and 21 Charles Place, Chicago, was slightly damaged by fire.

Armstrong & Co. have lately made several improvements in their foundry at Perryville, Md.

Fire in Terreau & Racine's foundry at Quebec, Can., caused a loss of $15,000 September 22.

L. J. Moftzger & Sons' foundry, at North Manchester, Ind., burned. Loss, reported $15,000.

The Union Foundry Co., of Grand Rapids, Mich., was visited by a small blaze September 14.

The Invincible Mfg. Co., formerly of Chicago, have erected a large plant at Wilmington, Ills.

The new foundry of the Kingston Machine Company, Wilkesbarre, Pa., has lately been in operation.

Ferguson & Sandifer have commenced the erection of a new foundry at El Reno, Oklahoma Territory.

Henry Disston & Sons, of Philadelphia, Pa., have let a contract for the erection of a new brass foundry.

Philip Carroll has erected a new foundry at Houghton, Mich., which will be put into operation at once.

The California Brass Works, 119 and 121 First street, San Francisco, was badly damaged by a recent fire.

The Barker Mine Car & Foundry Co., of Springfield, Ill., have lately made several improvements in their plant.

T. F. McGann's brass foundry, at 106 Portland street, Boston, Mass., suffered a small damage from a recent fire.

Harvie & Beckley, iron and brass founders of Harrisburg, Pa., have removed their works to new quarters.

The Bridgeton (N. J.) Iron Co., have lately turned out a number of heavy castings for the Ferracute Machine Co.

The Crescent Iron Works, of the Whitaker Iron Company, at Wheeling, W. Va., is being put in readiness to resume work.

The firm of Davitt, Shea & Co., founders, Springfield, Mass., has been reorganized under the name of Davitt & Shea.

The Michigan Iron Works, Manistee, Mich., idle for a number of years, have been started up by Fitzgerald & Meyer.

The Jesup Foundry, Machine & Mfg. Co., of Jesup, Ga., a newly organized company are building a foundry in that city.

The Central City Co-operative Foundry Co. has been formed at Jackson, Mich. A. C. Smith has been selected as manager.

The Syracuse Chilled Plow Co., of Syracuse, N. Y., have purchased the stock of the Economist Plow Company, South Bend, Ind.

The Stockton (Cal.) Agricultural Works have decided to rebuild the part of their plant which was destroyed by a recent fire.

Mr. Ohnstedt has retired from the firm of Mullica & Ohnstedt, iron founders, Algona, Iowa. Mr. Mullica will continue the business.

The Little Falls (Minn.) Iron Foundry, owned by John Denis, was totally destroyed by fire September 16. Loss, $6,000; small insurance.

The Bellwood Mfg. Co., Bellwood, Pa., capital $12,000, has been incorporated to conduct a general foundry and machine business.

The old Shippee Harvester Works at Stockton, Cal., known as the Stockton Car Machine and Agricultural Works, was burned September 20.

The works of the Youngstown (Ohio) Bridge Company were destroyed by fire September 22. Loss estimated at $100,000; partially covered by insurance.

The Crowe Foundry & Machine Company, of Middlesborough, Ky., has been incorporated with $5,000 capital stock. William Crowe is chief incorporator.

The Kansas City Car and Foundry Co., Kansas City, Kan., is contemplating the erection of a steel construction foundry building 104x144 feet, and is asking for propositions to build the same.

The Vandalia (Ill.) Foundry & Machine Co., Benjamin Craycroft, proprietor, have entered the manufacture of brick machinery and already achieved considerable success with their Eagle brick machine.

The Vulcan Iron Foundry Co., of Pawtucket, R. I., has purchased the Pawtucket Brass Foundry from the A. T. Atherton Machine Co., and will move the plant to the new location of the former company.

Plans for a new building for the Waterloo Gas Engine Co., Waterloo, Ia., are now being made. The building is to be of brick, costing $5,000, and will include a machine shop 50x100 feet, and a foundry 40x70 feet.

The Iowa Iron Works, limited, is the name of a new company organized at Dubuque, Ia., with a capital of $100,000, to carry on the plant of the old Iowa Iron Works, which built the government boats Ericsson and William Windom.

The Singer Mfg. Co. is reported as having closed a deal whereby they intend to occupy the lately vacated shops of the Economist Plow Co. as a foundry. Local papers announce alterations being made to suit the new occupants.

Sutton Bros. & Bell, of Indiana, Pa., have received several orders from such foreign

countries as the Argentine Republic, New Zealand and the Hawaiian Islands.

The Rochester (N. H.) Foundry and Machine Co. had their foundry badly damaged by fire Sept. 27.

The Webster & Pitt foundry at New Albany, Ind., which has been idle for the past two years has been leased by Messrs. Gardner & Dugsdale, former employes of the Dennis Long Iron Works, Louisville, Ky. A number of improvements will be made.

Fletcher W. Heath, of Hamilton, O., Fred W. Heath, J. C. Johnson and A. W. Brady have purchased the Commonsense engine works at Muncie, which have been idle a year, from Receiver C. M. Kimbrough, and will start the works at once, giving employment to 100 hands.

The Indiana Steel Castings Co., Montpelier, Ind., went out of existence a few days ago and was succeeded by the National Steel Castings Co. The Indiana Steel Castings plant was one of the Montpelier concerns built to secure a subsidy. After it was built the company was unable to operate it because of lack of funds.

As a result of the reorganization of the United States Car Co., which has been in progress for several months, the Illinois Car & Equipment Co. has been organized to succeed it. O. M. Stinson, of Anniston, has been chosen superintendent of the southern plants, at New Decatur and Anniston, Ala., and is now in charge.

Mr. Edward M. Twiss and Mr. Edward W. Murphy, of Florence, Mass., have taken the foundry at the Valley Pump Co.'s shop, East Hampton, Mass., and there is life once more in that well-equipped shop. Mr. Twiss has been foundry foreman for the Florence Machine Co. for years. Mr. Murphy learned his trade under Mr. Twiss and has been for a long time in the employ of the same concern.

The Foxboro (Mass.) Foundry and Machine Co., whose plant was destroyed by fire September 14, will rebuild at once. The foundry will be 137x82 feet, and will be built of stone and iron. The machine shop will be 35x96, built of brick and iron. The Berlin Iron & Bridge Co. have the contract for the iron work. It is expected to be completed by the first of November.

The large buildings of the Foxboro (Mass.) Foundry and Machine Co. were burned to the ground September 14, causing a loss of nearly $40,000. The foundry was started in 1781 and was first used for the casting of cannon and cannon balls for the Continental army. For many years the business was run by Otis Cary, and the property is now owned by the heirs of Mr. Cary. The buildings and stock were insured for about $20,000.

The plant of the Union Malleable Iron Co., at Moline, Ill., is to be increased in size one-third by additions soon to be started. A continuation of the present foundry 96x64 feet is to be built. The new equipment will include a 10-ton air furnace, and 24 jib cranes to be supported by the roof, and arranged to supply each floor. The company will also install molding machines, made from its own designs, and which have proved of high efficiency.

Obituary.

Elliot E. Bradish, foreman of Luther Shaw & Son's foundry at Worcester, Mass., died in that city Sept. 27.

A. Moore, manager of the R. A. Moore & Co.'s foundry, at Wytheville, Va., was instantly killed by the bursting of an emery wheel, Sept. 22.

W. W. Speer, senior member of the firm of Alexander Speer & Sons, plow manufacturers, Pittsburg, died in Allegheny, Monday, October 11, aged 59 years. Mr. Speers had been in the iron business all his life, and was at one time president of the Pittsburg Forge & Iron Co.

Albert L. Ide, senior partner of the firm of A. L. Ide & Son, proprietors of the Ide Engine Works, Springfield, Ill., died at Chetek, Wis., Sept. 30, aged 56 years. Mr. Ide was connected with a number of enterprises, but is best known as the builder of the "Ide" and "Ideal" engines.

Harvey T. Litchfield, who died recently in Boston, was born October 30, 1830, in Scituate, Mass. When a little over 20 years of age he started a small brass foundry in East Boston, and gradually increased his business until 300 workmen were employed. His foundry turned out the first large rudders

and propellers used by the United States navy during the Rebellion.

William Guttenberger, a pioneer resident of Sacramento, Cal., and formerly a member of the Board of City Trustees, died September 15 at Dutch Flat, Placer county, Cal., where he had gone in search of health. Guttenberger built the first iron foundry in Sacramento in 1850, and continued in that business up to the time of his death. He was a native of Germany and 68 years of age.

Mr. Franklin Smith, president of the G. W. & F. Smith Iron Company, Boston, died at his residence in that city Oct. 1. Mr. Smith was born in Boston Oct. 16, 1831, and resided there all of his life. He was a nephew of G. W. Smith, one of the pioneer iron manufacturers of the city and the founder, in 1836, of the concern of which Mr. Franklin Smith was the recent head. Mr. Smith was admitted to the firm in 1853.

John Davies died of heart failure September 16 at his home, 307 Fourteenth street, Brooklyn, N. Y. He was 64 years old. Mr. Davies was born in the village of Clydach, Wales, and came to America at the age of 17. In 1861 the foundry of Howell & Saxtan, in Brooklyn, was established, and Mr. Davies became its superintendent. When, after thirty years this firm was dissolved, Mr. Davies built a foundry and established a business with his son, John I. Davies, in South Brooklyn.

Henry Ott, vice-president and secretary of the Ahrens & Ott Mfg. Co. of Louisville, Ky., and one of the founders of the company, died October 9, from lockjaw, resulting from a fall a short time ago.

Mr. Ott was born in Dissengen, Germany, February 3, 1843. At an early age he came to this country and learned the plumbing trade with Mr. Theo. Ahrens, afterwards being admitted into partnership under the firm name of Ahrens & Ott. Out of this humble beginning sprang the Ahrens & Ott Mfg. Co., in which Mr. Ott was always a prominent, hard-working and efficient officer.

William B. Bement, the well-known Philadelphia manufacturer, head of the machinery-building firm of Bement, Miles & Co., died at Philadelphia, October 7, aged 80 years. The deceased was born in Bradford, N. H., May 10, 1817, the son of Samuel Bement, who combined the callings of farmer and village blacksmith. At 17 he became apprenticed to a machinist at Petersborough, N. H. He served but two years out of the three for which he had been bound, when his abilities were such that he was taken into the firm. In 1842 he removed to Indiana to superintend machine shops at Mishawaka, but before he arrived the works burned to the ground. In 1847 he returned to the East, built cotton and woolen machinery for the Lowell Machine Shops, and ultimately assumed management of the pattern and designing departments. He retained this position for six years, and by it made a reputation as an inventor, designer and draughtsman. He went to Philadelphia in 1851, accompanied by his nephew, G. A. Colby, and they associated themselves with E. D. Marshall, the owner of machine shops, from which the present establishment of Bement, Miles & Co. grew.

The Murray Molding Machine.

One objection which the average foundry doing a general business has found against the general run of molding machines, has been the cost of providing special patterns

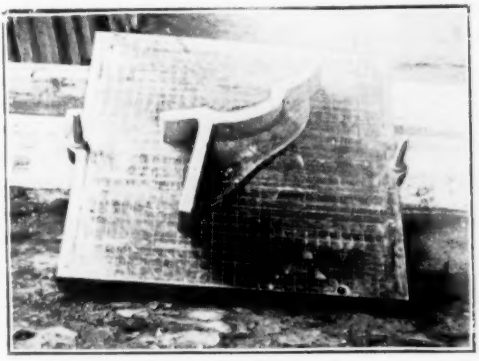

FIG. 1.

and matchplates. The expenses connected therewith has prevented the use of molding machines in any but special jobs, made in large quantities.

We illustrate herewith a machine which has been designed with the object of using any pattern, as ordinarily made, without spe-

cial preparation, and also constructed to take flasks of any depth. With split patterns nothing is required but the use of the plate shown in Fig. 1. This plate is made to fit both cope and drag and has drawn across it at right angles a number of lines, equally divided,

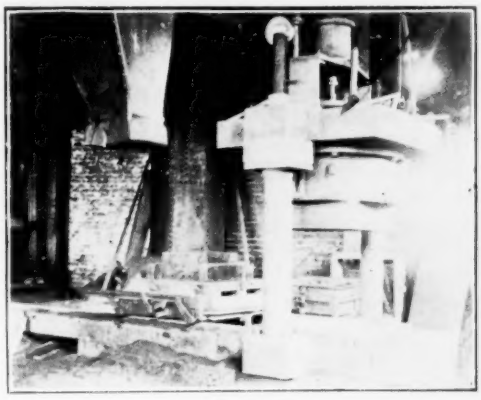

FIG. 2.

by which the adjustment of the pattern on either cope or drag side becomes an easy matter. In operation the pressure is applied from the top, avoiding the danger of shifting the pattern from its correct position.

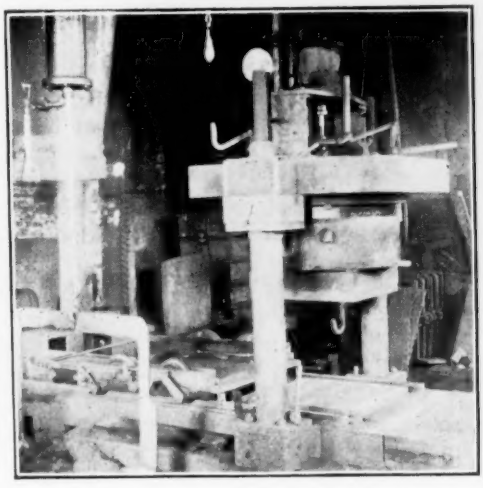

FIG. 3.

When patterns are irregular and require a follow board in ordinary molding, the only extra cost incurred in using them on this machine is to provide an extra follow board for the cope, the reverse from the one used for the drag.

Fig. 2 shows the machine as it appears in operation, with a follow board of this type and a pattern upon it for a railroad truck end. The machine is built in any desired size and copes and drags of different depths may be used to save excessive sand, without making any changes in the machine outside of supplying an extra thickness below the follow boards. With two trucks in operation, there being only one shown in Fig. 2, the capacity of the machine may be vastly increased.

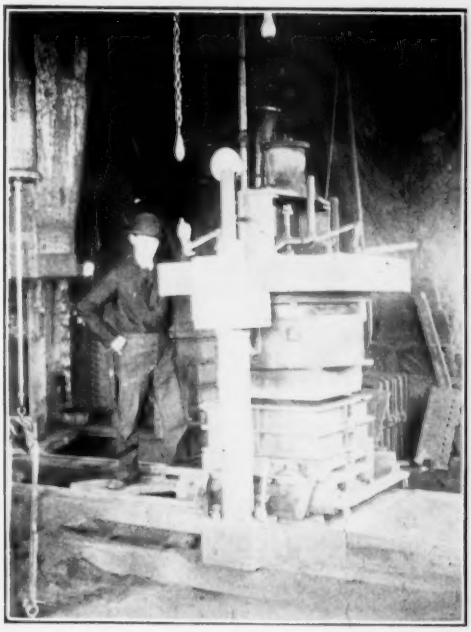

FIG. 4.

Figs. 3 and 4 give different views of the machine, which may be operated by either steam or compressed air, though the use of the latter is recommended for various reasons. The machine is the invention of a practical molder, J. B. Ramp, foreman of the Murray Iron Works, Burlington, Iowa. It can be seen in operation at their works and we understand they are preparing to place them on the market. Its adaptability to all classes of work and its ability of being operated in a small way or extensively should offer a wide field for its introduction.

The Value of Physical Tests.*

By S. S. KNIGHT.

The advent of various systems for the grading and mixing of irons by physical tests has led me to think that this topic, although old, may yet afford opportunity for investigation. Especially within the last year has much antagonism been shown between the exponents of these systems of physical testing and consequent foundry regulation and those who are using the means of chemical science to the same end. It is a strange, but nevertheless noteworthy, fact that the promulgators of mechanical testing have but one criticism to make on the work of their antagonists, and that is that their employment is not economical. As to how far their claims are substantiated by facts, we will now proceed to investigate.

According to the best authorities mechanical analysis is founded upon the discovery that the shrinkage in iron varies inversely as the silicon contained therein. Tersely speaking the measure of shrinkage is equivalent to the determination of the silicon. To experimentally determine if such be the case, two bars were cast one foot long and one-half inch square, the same being the measurements preferably used by mechanical analysis. Both bars were cast from the same ladle of iron, one with the metal very hot and the other after the metal had been re-heated by the addition of less than five-tenths of one per cent of ferro-manganese. Time was given for the surface of the metal to strongly glow and then the second bar was poured. The bars analyzed as follows:

FIRST BAR.

Silicon	2.256	per cent.
Phosphorus	.650	" "
Manganese	.712	" "
Shrinkage per linear foot	.11	in.

SECOND BAR.

Silicon	2.197	per cent.
Phosphorus	.648	" "
Manganese	1.112	" "
Shrinkage per linear foot	.17	in.

Both bars were cast in the same position, and aside from the treatment mentioned all conditions were held as nearly alike as possible. According to theory our proportion of silicon in the second bar should be 11:17::X (or silicon in the second bar) :2.256 or X=1.459. You will note that this is .738 per cent less than the actual silicon contained. We are not surprised that Mr. Keep and the other exponents of this system are more or less prejudiced against chemists at large if they suppose that one-half of one per cent is the ultimate accuracy of their practical knowledge.

Let us look at the same case from the practical side. Supposing we knew the silicon of the first and second bar and the shrinkage of the first, to find the shrinkage of the second, 2.256: 2.197::X (or the shrinkage of the second bar) :11 (the shrinkage of the first) or X=.15.

Suppose this iron were being used in a 24-foot cylinder flanged at both ends, then the error in estimating the shrinkage would almost be one-half of an inch or enough to insure both flanges shrinking off. And yet in the face of all this it is claimed that the physical test system is economical. Let us take a glance at how such saving would result from the use of this system in a shop casting one such cylinder in a flask every day. From our previous observation we see that if the rule were adhered to our casting would be lost regularly, and counting $10 as the total cost other than metal for such cylinders, we would have in one year of 310 working days $3,100 lost on the work alone, or enough to maintain a chemist and laboratory in opulence.

No doubt Mr. Keep will say that if the first casting is lost through shrinkage, any one would use more soft iron. In that case his system becomes but a means of guessing and not an accurate, scientific method. When capitalists' millions and all of the employment resulting therefrom are submitted to the chance of a guess, no theory that maintains such a performance can be called a discovery or its constant use be honored by the name of a system.

When it is stated that it was discovered that shrinkage varied inversely with the quantity of silicon contained in the metal, it should be known that the discovery was only partly made. The facts are that shrinkage varies directly as the content of sulphur,

* Paper read at the Cincinnati meeting of the Western Foundrymen's Association, October 18-20, 1897.

manganese, combined carbon and titanium, and inversely as the silicon and phosphorus content. However, this variation is in no case in a true ratio, since the more of the affecting metalloid the iron contains, the more is its action facilitated or hindered as the case may be.

We suppose that all will acknowledge that each foundryman should strive in every way to better his profession. If it were not for this constant groping after the truth and the actual facts, what would cause the large attendance at the meetings of the associations? In connection with this desire for facts, please think of two foundrymen, one possessing a laboratory and chemical facilities and the other with a testing machine, price $200. The first through constant experiment and careful analysis would soon become a master of his trade, while the other would be bound completely by the rules of the system he was using. He would be forced to bid only for work such as he had made, since he would be unable to form any idea of the requirements or cost of new work. While the first could be constantly cheapening his process and adding to his store of metallurgical knowledge, the second could never make any discoveries or advancements in mixing his metals. Let me give an example taken from fact of the actual utility of chemical facilities. A foundry never before having made alkali kettles wished to bid upon such work. A sample of an old kettle was obtained and analyzed. The work was secured and 15 ten-ton kettles made without a single loss. Such facts speak for themselves and show conclusively the actual value of scientific methods as applied to practical industries.

Of all the discoveries that have been made in recent years in iron metallurgical work there has been only one that a foundryman equipped with a mechanical testing outfit could possibly have made and it is a noticeable fact that even this was made by a chemist. I refer to Mr. Outerbridge's discovery; and here it would be well to observe that facts are found out and discoveries made only after patient, methodical, intelligent toil, and are very seldom, if ever, the results of lucky guesses or haphazard work. Doubtless had it not been for his chemical research along the line of his discovery Mr. Outerbridge never would have arrived at the conclusions which have made him so justly famous.

Before leaving this phase of our subject, let me cite another instance where chemical science scored a point that mechanical testing never could have made. While using high manganese irons we found that our test-bars made from these mixtures invariably broke, higher than a corresponding mixture of low manganese metal. Scores of analyses were made to prove the cause of this phenomenon and in every case high manganese was shown with no other phenomenal feature. Low manganese irons were tried having enough ferro-manganese added in the ladle to place the content of this element over one per cent. The results were the same as if originally high manganese iron had been used. The two test bars given below will show for themselves the advantage of gain in ultimate strength to be made in this manner. Both bars were cast on end and broken 36 inches between supports on a Riehle machine having the load applied at the center with a uniform acceleration.

First bar:

928 pounds breaking strain.
.88 inch deflection.
.971 inch thickness.
.13 inch to one foot shrinkage.
.950 inch width.

Its analysis was as follows:

Silicon	1.98	per cent.
Phosphorus	.558	" "
Sulphur	.050	" "
Manganese	1.002	" "

This bar had a small amount of ferro manganese added in the ladle, the iron being held until it flashed strongly before pouring.

Second bar:

736 pounds breaking strain.
.97 inch deflection.
.988 inch thickness.
.12 inch to one foot shrinkage.
.950 inch width.

The analysis of this bar was practically the same as of the first except in manganese, which was .712 per cent. It was also a plainly noticeable fact that the chill was

less deep and the grain more uniformly close. As far as known this work was original with the author, and although the gain in strength and diminished chill was so great no detrimental qualities were given the iron except the increased shrinkage which was directly due to the increase in combined carbon, which the metal took from the ferro-manganese.

Hundreds of corroboratory bars and other tests might be given, but these will prove the correctness of the statements made as well as any evidence could. In connection with manganese and its influences upon chill it will no doubt be interesting to know that many car-wheel foundries are using ferro-manganese to keep down the chill, and thus are at liberty to use greatly increased quantities of remelt in their mixture and very little pig metal. The ferro-manganese is added in the ladle as described and as much remelt carried as 85 per cent. The action of the manganese seems to be to increase the combined carbon and to eliminate the sulphur. The first effect will be readily explained by the analysis of ferro-manganese which will run about as fonows:

Manganese	80	per cent.
Combined carbon	8	" "
Iron	12	" "

The second or eliminating action has as yet not been satisfactorily explained although it is known that preferentially sulphur combines with manganese instead of iron. It is known, however, that the action is greatly facilitated by the presence of a basic slag and all metallurgists who have investigated the science of metallography agree that no pig metal even when cold is free from slag, so that when liquid, its presence is almost certain. Presuming this to be the case, the reaction would take place as in the basic steel furnace; the sulphur of the iron sulphide combining with the manganese and again combining with whatever base of the alkalies or alkaline earths that might be present. In cooling, this slag would naturally separate itself from the metal in a larger degree, and hence its method of eliminating sulphur.

While speaking of the relative value of physical tests, it may be interesting to consider briefly their worth as absolute measurements of the qualities of various materials. It will be understood that the value of any test is in a direct ratio to the similarity of composition and structure existing between the test piece and the finished product whose qualities are sought. Since Bessemer steel is more homogeneous than most other grades, tests taken from it are far more correct and more closely approximate the qualities of the heat than those taken from open-hearth billets. However, in the best Bessemer ingots the segregation of phosphorus is so great that tests taken before the metal has passed through the mill, are of little absolute value. How much greater then must be the chance of error in determining the qualities of cast iron which has been melted in a cupola, where the more fusible components of the iron mixture melt, and are tapped out leaving the more refractory to come out at some future tap.

It has been common experience in one of the large foundries that the first tap of the day was uniformly softer than that of any other time during the heat, when the same mixture was being charged on. A few analyses upon this point taken on three successive days may be of interest.

FIRST METAL TAPPED OUT.		
Silicon	2.739	per cent.
Silicon	2.981	" "
Silicon	2.624	" "

METAL FROM FOURTH TAP.		
Silicon	2.102	per cent.
Silicon	2.007	" "
Silicon	1.992	" "

In connection with what has been written of late upon the comparative fusibility of hard and soft metals, these analyses seem to bear valuable testimony. The author's intimation in a previous paper that invariably hard metals would fuse at a higher temperature than soft ones has been severely criticised. Lack of time has been the only cause for not making a number of experiments upon all brands and grades of metal to establish the truth in regard to this matter. However, the analyses given would seem to strongly support the author's theory, and it has been without exception our experience that regardless of the combination of metalloids, silicon is the most potent factor in determining the temperature at which cast iron melts.

Before concluding, one means of physical testing which has demonstrated its merit must be mentioned, and that is the microscope. The invaluable work which has been done in the last year by the foremost investigators in the field of iron metallography has made the microscope in the hands of the experienced and competent metallurgist, a necessary adjunct to every progressive steel and iron foundry. The discovery and isolation of martensite has cleared away the mists of ignorance and doubt concerning the cause of the famous phenomenon of Gore. It only remains for the chemist to settle forever the dispute of the eminent microscopists, Osmond and Howe, as to whether this martensite is an allotropic form of ferritic iron or but a kind of iron carbide, and if so to determine its composition. Personally it may be said that we have been using a microscope in our laboratory for the last year and it has given perfect satisfaction. The longer it is used the more necessary does it become and the more valuable does it prove itself to be.

The elaboration of the knowledge of the world upon the constituents of iron and its consequent physical properties has proved to be of great commercial value. For instance, in determining what iron to use in dynamo field castings, the amount of ferrite contained in the iron proves to be in proportion to the number of lines of forces per unit area that the metal will carry. Some pearlyte and cementite should be present, however, in order that the fields may possess the proper amount of residual magnetism. This shows one application of technical scientific knowledge to industrial work.

In conclusion it may be stated that the commercial value of a laboratory will be in direct proportion to the liberality of its equipment and to the competency of the operators employed. Practical tests will be found valuable only as they are made on reliable apparatus, and it may be put down for a fact that no system of testing or any machine will ever be equal to the ingenuity of a trained and competent man, situated with such facilities at his disposal that he may use his knowledge to the best advantage.

Molding Sand.*

By D. H. TRUESDALE.

In these progressive days when there is a constantly growing demand for castings of a better quality, and foundrymen are striving in every way to make better work, and in many cases failing to produce satisfactory results, it seems proper to call your attention to what I believe to be one of the most prolific sources of failure.

Molding sand being the most important factor in the production of good work, it follows that it is of the greatest importance that the utmost care should be taken in selecting sand that is the most suitable for the work to be made. At the same time it is important to obtain a more thorough knowledge of the elements of which the best sand is composed.

The first thing to be taken into consideration is what are the necessary elements of molding sand, and in what proportion should they be combined. There are four qualifications that are absolutely necessary; these are, refractory qualities, porosity, fineness, and a sufficient bond. Let us take these up in the order named.

First, refractoriness: The element which possesses this quality in the greatest degree is silica. Silica is found to be a component part in all the sand that is furnished to the foundryman, but often in such small proportions that the sand is absolutely worthless. Being practically non-fusible, it follows that sand containing the largest percentage of silica that it is possible to work will give the best results. Only sufficient alumina should be present to form a perfect bond in connection with the water necessary to make the bond complete.

My experience in the foundry business having been altogether in the line of light castings, such as stove plate, hollow ware, and work of a similar character, I shall confine myself to what I believe to be the best sand for work of that class.

I take it to be self-evident that the only properties necessary in molding sand are silica and alumina. The presence of lime,

* Paper read at the Cincinnati meeting of the Western Foundrymen's Association, October 18-20, 1897.

magnesia, metallic oxide, etc., are detrimental. Of course, I know that it is practically impossible to get sand with just the proper amount of silica and alumina in combination. To remedy this trouble, I have found the best way is to make the mixture yourself. To do this in a practical manner all that is necessary is to get the pure silica, or as nearly so as possible, and it can be got up to 95 per cent pure, and mix with a fine, strong sand containing at least 60 to 70 per cent alumina. It is impossible to give the exact proportions it would require in each case owing to the variation in the sands that are found in different parts of the country. Theoretically, the proper proportion of silica is 90 per cent to 10 per cent of alumina, but it will be readily seen that these proportions are, in the every-day hurry and push of the modern foundry, very difficult to keep up, as the clay in the strong, fine sand vitrifies, and adheres to the castings each day, so that the proportions would be changed after each heat.

I have found from practical experience that from 33 to 40 per cent of silica, with such sand as I spoke of before, gives the best results, making castings with a smooth surface and sharp lines; and also, what, in my estimation, is of greater importance, enabling the foundryman to dispense to a very large degree, with the use of foundry facings.

There are on exhibition here some specimens of "art" castings; also, some ordinary stove plate made in the manner spoken of, that will speak for themselves, which you are invited to examine.

Second, porosity: It is hardly necessary to say much about this, as every one understands its importance. It will be found that by the use of silica, owing to the crystal formation of the particles, this property will be preserved to a degree that will, in a great many cases, render venting unnecessary. I have seen large and intricate castings that have been considered hard to make, owing to the difficulty in venting them, made with complete success without the use of a vent-wire, which result was brought about solely by the use of silica sand.

Third, fineness: This is a matter for which there can be no rule, as the term fine sand is a very indefinite one. What one foundryman terms fine sand another would pronounce coarse; so the question of a proper degree of fineness must be left to individual judgment, in accordance with the work to be made. I wish to say, however, that in my opinion, a proper use of silica will enable the foundryman to use sand that is much finer than is commonly supposed possible on medium heavy work, thereby making castings of a better surface than with coarse sand.

Fourth, bond: By this is understood that constituent which joins and holds the particles of silica together during the process of pouring. For this alumina or clay is found to be the best, as silica, having absolutely no adhesive powers by itself, must have some material possessing the adhesive or "sticky" property necessary to hold the particles together while the mold is being filled. No more alumina or clay should be present than is necessary, as any increase over the proper percentage makes bad, rough work by its melting and adhering to the castings, causing extra expense in cleaning, and at the same time incurring the liability of loss; in many instances causing blow-holes, owing to the increased density of the mold, thus preventing the rapid escape of the gases.

As we have to use water to complete the bond, and depend upon it to keep the mold intact while being poured, it follows as a matter of course that the sand that will stand the use of the greatest amount of water is the best sand. In all cases as much water should be used as possible and at the same time prevent "blowing."

A judicious use of more silica in the sand will convince any foundryman of its value; and once having proven it, no backward step is likely to be taken.

The ideas presented in this paper are solely the result of several years experience in the use of silica sand having proven to my complete satisfaction its value in the production of good castings.

There is another feature in connection with silica that I have not spoken of, but it is well worth considering; that is, its use in making cores. It will be found on trial that cores made with it alone, and oil, will result in smoother, cleaner castings than any other

core sand, at the same time dispensing entirely with "core wash" of any kind, as the refractory powers of silica absolutely prevent any burning of the sand, causing the core to fall out at the tap of the hammer, leaving a very smooth, clean surface; better than I ever saw by the ordinary way of making cores. Also, the sand can be used over again immediately, as it is in no way injured or changed by having iron poured on it, except to be discolored by the burning of the oil, which does not alter its value. I have tried this repeatedly, and know from experience what I say is true. A trial will convince any one of the fact.

I cannot but believe that a more thorough study of the value of silica in molding sand will result in what all engaged in the business must admit is greatly to be desired: that is, the production of better and smoother castings, resulting in economy in cleaning, finishing, etc., as well as gratifying the pride of every true foundryman.

Progress of Compressed Air for Mechanical Purposes.*

By J. F. LEWIS.

The subject of compressed air and its uses offers a wide field of investigation. Compressed air is fast becoming an efficient agent for transmission of power. It is not a new power by any means, as we find experiments in compressing air were made more than a century before Christ, and its application to industrial purposes dates back to the last century, but its success as a mechanical power must be credited to the modern engineer of this day. In his hands it has become a powerful, efficient and most interesting agent.

It was first applied by Cubitt and Brunell in 1851-4 to the sinking of bridge caissons. The next engineering work where compressed air was used to any extent successfully, was in boring the Mt. Cenis tunnel.

In America, it was used by Mr. Walter Shanley in driving the Hoosac tunnel, from 1868 to 1874, where it proved very successful in the saving in cost of construction and time of completing the work. From this time on, the use of compressed air increased very rapidly for underground work—tunneling and mining.

There is no State in the Union where compressed air has been used to any greater extent than in Michigan, and she can boast of the largest air plants in this country, first adopted in the iron and copper mines of Lake Superior in about 1876, since which time—twenty-one years—there has been mined with compressed air 102,293,757 tons of iron ore, gradually increasing each year from 1,025,129 tons in 1877 to 10,596,559 tons in 1896. An average output of 4,871,131 tons per year. From the year 1870 to 1876 inclusive the output of ore was 6,591,789 tons, or an average of 941,684 tons per year. The number of pounds of copper mined from 1880 to 1897 in Lake Superior is 1,467,313,651. From this statement you can get some idea of what compressed air has accomplished in the United States during the last twenty years.

The application of compressed air for mechanical purposes was first started in Paris by Victor Popp, in 1879, consisting of two small compressors and two steam engines of 6 horse power each. This plant was first used to operate pneumatic clocks, and has now increased to 24,000 horse power for mechanical purposes.

In 1892 they compressed 6,887 millions of cubic feet of air. They have a system of 105 miles of compressed air pipe laid under the street, of which 41 miles is used for pneumatic clock service and about 64 miles for the transmission of power, used for the following work:

Lithographic presses, printing, stereotyping, circular saws and others, machines to cut cloth, pumps, grindstones, lathes, rolling presses, refrigerators, ice boxes, coffee grinders, roasters, etc., milling, drilling, planing machines, drying machines, liquid mixing apparatus, sewing machines and others, chopping, grinding machines, special sewing machines, cutting machines, silk looms, machines for electroplating, embroidering machines, tin-smith shears, ventilators, trimming manufacturer, carding, pressing, cleaning machines, comb factory, dynamo motors, machines for physicians, pharmacists and dentists, machines for seltzer, machines for bakery, wood working machinery, sieves, polishing machines, book binding machinery,

*Paper read before the convention of the American Foundrymen's Association, Detroit, May, 1897

letter envelope sticking machines, shoemaking machinery, motors for aero-heating (hot air), motors for ventilators, motors for dynamos and cold storage rooms, passenger and freight elevators, beer and wine raising, blow pipes.

They are also running street cars by compressed air, known as the Mekarski system.

The applications of compressed air for power purposes are very numerous and new work is found for it continually. There is, of course, great diversity of opinion and practice among engineers as to the means of transmitting power, either by steam, electricity, belt, wire rope or compressed air. Air, perhaps, is the only one that is in every case possible. It would be hard to find an engineering project in which air would not fit the conditions as a power.

Very little progress was made in the use of air for mechanical purposes, except in a very crude way, until the past five years. It is now becoming universal for use in machine shops, boiler shops, railway shops, and, I was going to say foundries, but we find very little work being done in foundries by compressed air. Some few foundries are partially fitted with air for hoisting and cleaning castings.

The Detroit Bridge and Iron Works write: "We are using compressed air for hoists and riveting, but know very little about it in connection with foundry work."

The Russel Wheel & Foundry Co. have recently commenced using compressed air in their construction work, working a pneumatic riveter, which proves most satisfactory.

The Link Belt Machinery Co. use air in their machine shop for air hoists and portable air tools; in their foundry for hoisting only.

The Bass Foundry and Machine Works use air in their boiler shop and in the steam forge department. They believe it could be employed to advantage in their machine and foundry departments.

The Deering Harvester Co. write as follows: "We probably have in use in the neighborhood of 75 to 100 pneumatic hoists for lifting various kinds of work in our factory. We use it in foundry practice, in handling our castings, for raising vertically and horizontally, we use it on testing machines, we use it on machines for pressing castings on to shafts and on many of our pouring cranes in our foundries, as well as numerous other small appliances and we cannot say too much for it. The writer feels like saying that the compressed air problem, or what can be done by compressed air, has not been reached by a great deal, and is in some respects on a line and par with electricity."

The Whiting Foundry Equipment Co. are using compressed air for operating elevator and conveyor for carrying iron, coke, etc., to the foundry charging floor, also for air traveling cranes, one of four tons capacity, one of five tons, and one of ten tons, and several vertical hoists in various parts of their plant. They also use it for operating

J. F. Lewis.

pneumatic chipper, caulker and riveter. They have no doubt of the economy, usefulness and efficiency of compressed air.

Edward S. Cramp, superintending engineer of the Wm. Cramp & Sons' Ship & Engine Building Co., Philadelphia, writes as follows: "We are using the compressor for the purpose of riveting, drilling and reaming, caulking ship and boiler work, blowing fires for rivet heating, cleaning castings, running punching and shearing machines that were formerly driven by steam, and we feel sure that this extended use of compressed air has resulted in an increased efficiency in the performance of our work."

Railway machine shops, locomotive works and boiler shops have made great headway in the use of compressed air. The A., T. & S. F. railway installed an air plant 2,000 cubic feet per minute, and are carrying this air through about five miles of pipe around their works. Since this plant was installed, they have purchased eight other compressors for the different line shops. They report a great saving in cost over the old method by using the Baird Portable Machine Company's tools run with compressed air. With the 10′ reach stationary riveting machine, they drive 2,000 rivets per day of ten hours with three laborers at a total cost of $4.75 per day. Compare this with hand labor: three men, total $7 per day, and driving only 200 rivets.

The 6′ riveter, combination flange punch and riveting machine, and the bridge and girder riveter, will each average about the same as the 10′ reach riveter.

The truck riveters, one machine operated by two laborers, total $3 per day, drive 3,000 rivets in a day of ten hours, as compared with hand labor, three men at a total of $6 in the same class of work will only drive 175 rivets.

The frame riveter will average about the same as the truck riveter. The stay-bolt breaker will make an average saving of $8 a day. The tank riveter will make an average saving of $10 a day. The mud ring riveter will drive as many rivets as can be handed to it, and will make a saving of from $12 to $15 a day for that class of work. Not only does it make a great saving, but it insures every rivet hole being entirely filled and insures tight work, while with hand driven rivets in mud rings a large per cent of them invariably leak and have to be calked or fullered up. The stay-bolt cutter will do the work of fifteen men. This machine will very easily cut off 1,500 bolts an hour, while when cutting off by the old method of hand hammer and chisel, it goes very slow and is hard work. The rotary tapping and drilling machine will do the work of four men. The rotary grinder saves the work of six men. Rotary saw for sawing car roofs saves the work of four men. Pneumatic hammer will save the work of three men. Crown bar bolt machine saves the work of three lathes. Rail saw saves the work of two men. Rail drill saves the work of two men. Devices for operating transfer table saves $6 per day. Device for revolving driving wheels for setting valves saves the labor of two men. Device for shearing bolts saves the labor of two men. Thirty hoists in shops save the labor of 10 men at $1.50 per day. Device for loading and unloading oil at storehouses saves $6 per day over the old method. Jack for pulling down car draft sills saves $10 per day. Device for fitting up hose couplings over the old method saves $15 per day. Pneumatic painting machines, one man does the work of ten using the hand brush. Machine for tearing down old car roofs saves $8 per day. Jack for raising and lowering freight and passenger cars makes an average saving of three men. Drop pit makes an average saving of three men. Device for sanding engines saves one man. Shifter for switching cars in shop yard saves $50 per week. Device for cleaning coaches saves ten men. Device for rolling flues makes a saving of two men over the old method. Device for white washing when in use, will do the work of ten men with a brush."

The Illinois Central Railway Co. installed an air plant in their new shops at Burnside of about 2,000 cubic feet free air per minute In a letter from Mr. Wm. Renshaw, superintendent of machinery, he says:

"We are at present using compressed air for the following purposes: Elevating sand at engine sand house, elevating oil at oil house, hoisting heavy castings and parts at machine tools, etc., forcing couplings on air hose, operating cylinder boring bar, operating valve facing machine, filling cylinder of hydraulic presses, removing and applying driving tires, testing water pumps after repairs, drilling with motor, tapping with motor, reaming with motor, cleaning boilers, cleaning machinery, punching jacket rivet holes, taking old paint off tin roofs, rolling and beading flues, chipping, cutting, caulking, small bull dozer, elevating water from deep wells, testing air and driver brakes, elevators in store house, operating letter presses, cutting out stay bolt stubs, jacking up cars and trucks, cleaning interior of coaches, cleaning upholstered work, burning paint off coaches, painting cars, sand blast ends of cars, gasoline heater, cutting off stay

bolts, screwing in stay bolts, rivet forges, one blacksmith forge, pressing in driving box brasses, operating flange clamp, swedging flues.

"This is the list up to date, but we are finding further use for compressed air every day, and we could not afford to be without it.

"I consider it the best means of transmitting power in and about shops: First, on account of the many uses to which it is adapted and the simple appliances needed in connection with its use. Second, with but few exceptions in the above list, steam and electricity could not perform the work without more complicated apparatus, and in a great many instances, air alone is applicable. Third, the appliances used and the pipe line are easily kept in repair by our own shop men. Fourth, there is no element of danger and the apparatus requires no skilled mechanic to handle same, and it is safe to use in places where steam or electricity might be objectionable. Fifth, it can be carried greater distances without loss than steam, and taking into consideration cost of plant, cost of maintenance, skilled help required, etc., it can be produced for less money than electricity.

"As regards saving made over old methods, would say, taking into consideration all things, that an average all round saving of 25 to 30 per cent could easily be realized. Take, for instance, the saving effected by use of air hoists alone, which, though hard to figure, will assume large proportions when the amount of labor they take the place of is taken into consideration.

"We figure a saving of 60 per cent in burning paint off passenger cars, and 50 per cent in painting freight cars and passenger car trucks."

Mr. J. H. McConnell, superintendent M. P. of the Union Pacific R. R., says: "The many savings through the use of air in the shops of the Union Pacific system aggregate $10,000 per year in labor alone."

Similar statements to the above may be made of the Chicago & Northwestern Ry.; Chicago, Rock Island & Pacific; Michigan Central; Detroit, Lansing & Northern; Grand Trunk; Great Northern; St. Paul & Duluth; Pennsylvania System; Cleveland, Cincinnati, Chicago & St. Louis, and many other railways who are using air extensively.

The question is often asked, "Is compressed air economical?" We answer: Yes, if an economical plant is installed; but a better answer is made by the railways, as no class of mechanics or business men study economy so closely as railway men, and we point to what they are doing with compressed air.

The foundry is the birth-place of all that is grand and beautiful in iron construction. Go to Pullman—visit the Pullman shops, and you will see a grand structure that came from the brains of Corliss—an engine of 2,000 horse power, sending power through the extensive shops of the Pullman Company. This engine was built to run the machinery at the Centennial Exposition in Philadelphia, now 21 years old, but it is to-day seemingly as young as ever. This wonderful machine was born in the sand.

Visit the Michigan Stove Company's works and you will see a combination of beauty and art that will remind one of a flower garden (perhaps I should have said a "Garland" of roses), conceived in the brain of man but born in a foundry. There is no doubt an equal opportunity to economize work in the foundry as in other branches of the industry.

In a letter from an expert consulting engineer on foundry practice and equipment, one who is well up in the business and stands high in his profession, but whose modesty would not permit his name to be used, he writes as follows: It is my opinion and experience that compressed air can be economically used in all processes in the modern foundry. Primarily, I consider it the very best means of conveying the sand into the foundry and distributing it to the various floors of the molders. Secondly, it is an excellent assistant for the molder in cleaning his molds by jets of air under pressure. Thirdly, I consider compressed air heated to the temperature of about 400 degrees and introduced into a closed mold as the very best and most efficient method of drying these molds preparatory to casting, and I believe the future will see great developments in this line. A mold which ordinarily takes from 8 to 10 hours to dry in a core oven with very uncertain results can be positively dried in 20 to 25 minutes by the use of hot

compressed air under a pressure of from 3 to 5 pounds, and the result is absolutely certain and perfect. Furthermore, by this method the steam generated in the mold finds its way outward to the sand and vents, the latter in a much more perfect manner than when dried from the outside in an oven. Fourthly, compressed air in its use as a hoisting power in handling flasks, ladles, cores, etc., is now recognized as the best and most efficient method of doing such work. Fifthly, the use of compressed air for cleaning castings by means of pneumatic tools, sand blast apparatus, etc., is also thoroughly recognized and well developed, and the efficiency and economy of this method for cleaning is beyond question. Sixthly, the use of compressed air in a cupola for melting iron is well known, although the pressures here rarely exceed 10 to 15 ounces. Seventhly, the application of hot compressed air in core ovens for drying cores is another step to be taken in modern foundry practice, as it permits of rapid and sure work without the danger of burning cores, or of leaving same raw, which is constantly present in the core ovens as constructed and used now-a-days.

These heads comprise the particular applications of compressed air in the foundry and also comprise in a general way all the manipulations in the producing of castings, so that it is perfectly safe to state that economy and efficiency dictate the use of compressed air in every step in the production of castings from the raw material to the finished article.

The Buckeye Coal Oil Arc Lamp.

We illustrate herewith the Buckeye Coal Oil Arc Lamp, which is specially designed for the lighting of foundries and gives a light of from 500 to 4,000 candle power as may be required, according to the size of lamp. The inventor of this lamp, Mr. Macleod has had many years' experience with this character of light both in Europe as well as in this country, and it has many distinct advantages over electric light for foundry use. It is portable and can be moved to suit the work, thus if it is required to concentrate more light on any particular work being done the lamps can be brought to bear on this work; perhaps, however, the best manner of describing the value of the light would be to relate an incident that occurred in the sale of same. On calling at the iron foundry and seeing the proprietor, also the foreman, Mr. Macleod was informed that they used ordinary torch lamps and did not require anything further, in fact they had no use for the light. On finally obtaining their consent to show the light at work in the foundry some evening when casting, the lamp was sent and started, and although the foundry was full of steam and smoke, a newspaper could be read in any portion of the foundry, the light penetrating the smoke easily and the foreman was so delighted that he states now that he would not be

without it at any price. The flame can be adjusted vertical or horizontal just as desired. The lamp burns crude or refined oils economically and safely, and requires no skilled attention, any ordinary laborer being able to start it and it will burn for hours without any attention whatever. To responsible firms the makers are willing to send a light on trial and approval so that if their statements are not correct the intending purchaser is not put to any expense. The makers of the lamp are Macleod & Clark, 463 East Front street, Cincinnati, O.

NOTICE!

Advertisements in this column, 30 cents a line for each insertion. About seven words make a line. The Cash and Copy should be sent to reach us not later than the 20th to insure publication.

Answers addressed to our care will be forwarded.

TO SUBSCRIBERS

whose names appear on our **subscription** list, we will give one free insertion under this heading to those in want of positions, the advertisement to occupy a space of not more than five lines. Additional space or insertions must be paid for in advance at regular rates.

FOR SALE—No. 3 Root blower, used only a few months; to be replaced with largest size. Address Box 4, care THE FOUNDRY PUBLISHING CO.

FOUNDRY FOREMAN wants a position. Capable of working sand or loam. Well versed in mixing and melting iron and can handle men to advantage. Address E. J. J., box 95, care THE FOUNDRY.

A FOUNDRY SUPERINTENDENT, or foreman, of recognized ability, will be open for engagement Jan. 1, 1898. Best references; 20 years' experience, 8 as foreman in light castings. Good habits. Address Box 94, care The Foundry.

WANTED—A first-class foundryman with about $3,000 to invest in a high-grade foundry. Splendid location and good business from the outside. Market rapidly expanding. For particulars address M. X., box 96, care THE FOUNDRY.

WANTED—A situation as brass foundry foreman. Have had twelve years' experience on both light and heavy castings and can come well recommended as to my ability in mixing metals and handling men. Address Box 97, care The Foundry.

FOR SALE—Foundry and machine shop at Des Moines, Iowa, fully equipped. Will sell the personal property and lease the real estate for a term of years with option. Des Moines is the largest and best city in the state for manufacturing. For particulars address S. D. WILSON, 219-23 East First St., Des Moines, Iowa.

A GENTLEMAN well known to the foundry trade will be at liberty shortly to accept a position as manager or superintendent of a foundry plant. Is a practical mechanic in all that pertains to foundry practice, both in iron and brass, chilled rolls, car wheels, etc., and capable of handling a large number of men with best results; is a thorough business man in buying, selling, making estimates and contracts. For a number of years past has been manager and conducted the entire business of a large foundry plant; highest references furnished. Address box 93, care THE FOUNDRY.

Stevenson, Field & Co., of Columbus, Ohio, have established an eastern office at 616-617 Vanderbilt Bldg., New York city, which will be managed by Jas. V. Umberger. This firm are exclusive selling agents for "Pencost" high silicon pig iron, also for Spearman American Scotch, besides representing several standard brands of southern irons. Connellsville, Virginia and West Virginia coke is also handled by this firm.

George F. Crivel, who has been in the foundry supply business for a greater length of time than his youthful and happy appearance would seem to indicate, is now traveling in the interest of F. B. Stevens, Detroit, Mich.

The Smooth On Mfg. Co., of Jersey City, N. J., have issued, for gratuitous distribution to those interested in the production of castings, a pamphlet describing the merits of their well known preparations, "Smooth On Castings" and "Smooth On Cores."

The former is used to repair defects in castings and annually saves many of these, which would otherwise be condemned as useless. The repair is permanent and as it assumes the same hardness and color as the iron can be used without detection. Manufacturers of heating apparatus, where a flaw in the castings often remains unnoticed until the application of pressure, have found this preparation of great value as shown by the testimonials attached.

"Smooth On Cores" is a liquid core compound, which gives to the cores a greater strength and largely does away with the necessity for rods, thus permitting the easier removal of the sand after casting. Cores made with this compound may be kept for any length of time without deteriorating and its use insures the absence of offensive odors or smoke. Other favorable points are dwelt upon in the pamphlet, which can be had free upon application.